Rekem

A *Federmesser* Camp on the Meuse River Bank

Volume I

Marc De Bie

& Jean-Paul Caspar

Instituut voor het Archeologisch Patrimonium

Leuven University Press

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on the Meuse River Bank

Archeologie in Vlaanderen

Monografie 3

Uitgegeven door / edited by
Prof. Dr. Guy De Boe

&

Acta Archaeologica Lovaniensia

Monographiae 10

Cover: Benoît Clarys

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Leuven

2000

Een uitgave van / Published by

Instituut voor het Archeologisch Patrimonium
Institute for the Archaeological Heritage
Wetenschappelijke instelling van het
Ministerie van de Vlaamse Gemeenschap
Departement Leefmilieu en Infrastructuur
Administratie Ruimtelijke Ordening, Huisvesting
en Monumenten en Landschappen
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Tel.: + 32 (0)2 481 80 30
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&

Universitaire Pers Leuven
Leuven University Press
Katholieke Universiteit Leuven

Blijde-Inkomststraat 5
B - 3000 Leuven

Tel.: + 32 (0)16 325345
Fax: + 32 (0)16 325352
E-mail: university.press@upers.kuleuven.ac.be
Internet: http://www.kuleuven.ac.be/upers

ISSN 1370 5768
ISBN 90 7523 013 4
D / 2000/6024/1

ISBN 90 5867 011 2
D / 2000/1869/2

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Voorwoord

Er zijn weinig regio's in Europa die zo dichtbevolkt zijn en dit in het verleden ook waren als Vlaanderen en waar bijgevolg de menselijke invloed op het landschap en de bodem zo intens is. Daardoor heeft Vlaanderen een bijzonder rijk bodemarchief dat een schat aan gegevens bewaart over de geschiedenis en levenswijze van onze voorouders. De opgravingen die in de eerste helft van de jaren 80 nabij de Maas, aan de grens van de deelgemeenten Neerharen en Rekem werden uitgevoerd, hebben bovendien als zelden voordien aangetoond hoe intensief die bewoning op bepaalde plekken is geweest en hoe omvangrijk en dicht dit bodemarchief kan zijn: nagenoeg elke periode uit ons verste tot meer recente verleden is er in min of meerdere mate vertegenwoordigd.

Om een integraal en preventief beheer van dit patrimonium mogelijk te maken via de bescherming van de waardevolle en door noodonderzoek van de bedreigde sites, is het noodzakelijk om over voldoende beleidsinformatie te beschikken. Als wetenschappelijke instelling die instaat voor alle aspecten die verbonden zijn aan het beheer en de wetenschappelijke studie van het archeologisch archief, speelt het Instituut voor het Archeologisch Patrimonium onder de vele actoren op het veld een centrale rol. Belangrijk is daarbij de coördinerende en kwaliteitsbewakende taak die het IAP moet verzekeren. Dit houdt in dat het IAP niet alle uitvoerende taken zelf moet uitvoeren, maar ook de andere actoren in het veld bij het beheer en het onderzoek moet betrekken en hun werk maximaal moet ondersteunen.

Samenwerking is dan ook aangewezen om met bundeling van middelen en kennis samen te verwezenlijken wat elke partij afzonderlijk niet of slechts op onvoldoende wijze kan. De voorliggende studie is een mooi voorbeeld van een dergelijke vlotte en vruchtbare samenwerking tussen het IAP en de universiteit, waarbij elke instelling vanuit haar specifieke opdrachten en bevoegdheden een complementaire bijdrage leverde. Eerst op het terrein zelf, wanneer de toenmalige Nationale Dienst voor Opgravingen, voorloper van het IAP, in het kader van grootschalige noodopgravingen op het Labo voor Prehistorie van de Katholieke Universiteit Leuven beroep deed om het onderzoek van de relicten uit de steentijd op zich te nemen; later wanneer vorsers van beide instellingen samen de minutieuze wetenschappelijke verwerking van de bereikte onderzoeksresultaten en vondsten realiseerden; nu tenslotte met de gezamenlijke publicatie van deze omvangrijke studie in de monografieënreeks van IAP en KULeuven.

Met deze wetenschappelijke publicatie, die naar mijn overtuiging zowel in binnen- als buitenland sterk zal gewaardeerd worden, vervulden beide instellingen een belangrijke stap in hun plicht tot ruime bekendmaking van hun onderzoek. Naast de wetenschapper zal ook de sterk geïnteresseerde leek hierin de nodige informatie kunnen vinden om op een zeer indringende manier in contact te komen met de levenswijze van de bewoners van een in Europa zelden zo grootschalig onderzochte laatpaleolithische nederzetting. Om het behoud van dit minder monumentale maar uiterst kwetsbare erfgoed beter te kunnen verzekeren, is het evenwel van het grootste belang dat de wetenschapsarcheologie zich naar de toekomst meer en meer vertaalt in een publieksarcheologie. Het ware dan ook wenselijk dat deze wetenschappelijke publicatie een vervolg zou krijgen in een bevattelijk voorgestelde publicatie voor een breed publiek, dat even veel als de wetenschapper geïnteresseerd is om nader kennis te maken met de levenswijze van zijn verre voorouders.

Met deze samenwerking zijn het IAP en het Labo voor Prehistorie van de KULeuven geslaagd in het vervullen van onze gezamenlijke plicht om deze bron van inspiratie en creativiteit in stand te houden voor deze en toekomstige generaties.

Johan Sauwens

Vlaams minister van Binnenlandse Aangelegenheden,
Ambtenarenzaken en Sport
bevoegd voor Monumenten, Landschappen en Archeologie

Acknowledgements

The aim of this two-volume book is to present a reconstruction of prehistoric life in one of the largest Palaeolithic campsites excavated in NW Europe. The project began in 1984, when the site was found during the large-scale excavations of Protohistoric, Gallo-Roman and early medieval structures by the former Belgian *Nationale Dienst voor Opgravingen*. Many people were engaged in the fieldwork on the *Federmesser* site at the time, and we would like to thank all the students and other members of the team for their hard work under the expert direction of Drs. Robert Lauwers.

This publication would not have been possible without the longstanding and valued co-operation between the two institutions involved in the Rekem-project: the *Laboratorium voor Prehistorie (Katholieke Universiteit Leuven [K.U.Leuven])* and the *Instituut voor het Archeologisch Patrimonium* (I.A.P, Vlaamse Gemeenschap). Their respective directors have also substantially contributed to the realisation of this publication: Prof. Dr. Pierre M. Vermeersch as the scientific supervisor of the whole enterprise and Prof. Dr. Guy De Boe as the editor of the series '*Archeologie in Vlaanderen*'. We are greatly indebted to their active interest and support.

In terms of financial support, we gratefully acknowledge additional funding from the Wenner Grenn Foundation (grant-in-aid 4949), the K.U. Leuven Research Fund, the Programme on Interuniversity Poles of Attraction (I.U.A.P. no. 28), and several private sponsors, especially Mr. Léon Hermans (*v.z.w. Maasland*), Mr. Philippe Gantois (*Belgatech*) and the *Trappistenabdij Westmalle*. The *Commissie voor Publicaties* and the *Faculteit Letteren* of the K.U.Leuven provided a substantial amount to the publication costs. Mrs. Hilda Gielis-Lens was very helpful in our dealing with the Leuven University Press. Mrs. Gita Coene expertly designed the layout of both volumes.

For their constructive comments and encouragement, we wish to express our gratitude to Boris Valentin (Paris), Philip Van Peer (K.U.Leuven), Marc Waelkens (K.U.Leuven) and Wil Roebroeks (Leiden). Earlier drafts of sections of the manuscript were critically commented on by colleagues, including Patricia Anderson (Valbonne), Laurence Burnez-Lanotte (Namur), Ruth Charles (Oxford), Charles Frank Herman (Leuven), Nicole Pigeot (Paris), Jacques Pelegrin (Paris) and David Van Reybrouck (Brussels), all of whom suggested ways in which to improve the clarity of the text. Alex Gibson (English Heritage, London) kindly accepted to revise the final version and to polish up our English. We are extremely grateful to all of them, but willingly accept responsibility for any omissions or errors that might still appear.

Numerous contacts with colleagues abroad enriched our understanding of the Late Palaeolithic in Europe. For their hospitality and interest during our visits and for the engaging comments on their personal work, we would like to thank: Jean-Pierre Fagnart (Amiens), Paule Coudret (Amiens), Boris Valentin (Paris), Pierre Bodu (Paris), Sylvie Beyries (Valbonne), Gerhard Bosinski (Neuwied), Harald Floss (Macon), Martin Street (Neuwied), Michael Baales (Neuwied), Stephan Veil (Hannover), Ruth Charles (Oxford), Nicholas Barton (Oxford), Roger Jacobi (London), Jill Cook (London), Wil Roebroeks (Leiden), Eelco Rensink (Leiden), Jan Kolen (Leiden), Dimitri De Loecker (Leiden), Leo Verhart (Leiden), Nico Arts (Eindhoven), Jos Deeben (Amsterdam), Philippe Crombé (Gent), Dick Stapert (Groningen), Romuald Schild (Warsaw), Jan M. Burdukiewicz (Wroclaw), Slavomil Vencl (Prague) and Berit Valentin Eriksen (Aarhus). Several of these visits abroad, as well as participation in conferences at Leiden, Amiens, Oxford, Warsaw, Wroclaw, Prague, Eindhoven, Groningen, Forli, Neuwied, Grenoble, Nemours, Valenciennes, Cape Town, and Stockholm, were partly supported by the Fund for Scientific Research-Flanders, the Institute for the Archaeological Heritage (I.A.P) and the British Council.

With the exception of some of the maps and lithic drawings done by Robert Geeraerts (K.U. Leuven) and Christian Casseyas (Ramioul), the illustrations and maps were drawn by Marc Van Meenen (I.A.P.), whom we thank for his constant efforts. It is due to the talent of Ludo Cleeren that even the most stubborn refits eventually got photographed as well. Veerle Rots kindly assisted in the preparation of the microscopic photographs. We are also grateful to Benoît Clarys for accepting to create the fine cover illustration.

The major part of this research has been conducted in the accommodation of the Institute for Earth Sciences at the K.U.Leuven. Annemie Van Elsen and Jos Meersmans were always helpful in solving secretarial matters and computer problems. For their encouragement and wisdom, the authors wish to thank colleagues Philip Van Peer, Etienne Paulissen, Charles Frank Herman, Frans Steenhoudt, Dirk Huyge, Veerle Rots, Bart Vanmontfort and Shawn Bubel. For their help during the refitting work, we wish to thank Cyriel Verbeeck and Chris Peleman. Louis Pirnay (Ramioul) and Anne Hauzeur (Brussels) were very helpful during the arrow shooting experiments.

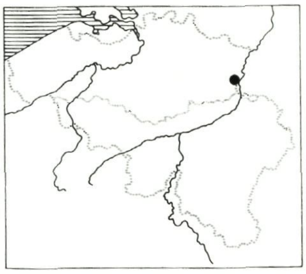
For their tolerance, moral support and affection, Marc De Bie is eternally indebted to Els, Jef, and Jan. Jean-Paul Caspar wishes to thank Elisabeth for her relentless support. He is also grateful to Emilie for her affection and for the infinite patience she showed toward her father.

Finally, it should be emphasised that this book is the result of many years of intense collaboration and lively discussions between the authors. These efforts were, however, justified only because of the exceptional importance of the site of Rekem. Understanding this, and directing an excavation with the necessary care, attention to detail, but also with the larger picture in mind, has been the merit of Drs. Robert Lauwers. He also conceived the general framework of the present work, at a time when making a living doing archaeological research in Belgium was extremely difficult. Therefore we believed it to be appropriate to dedicate these volumes to his great talent.

Marc De Bie (I.A.P.)

Jean-Paul Caspar (K.U.Leuven)

1 Research Context



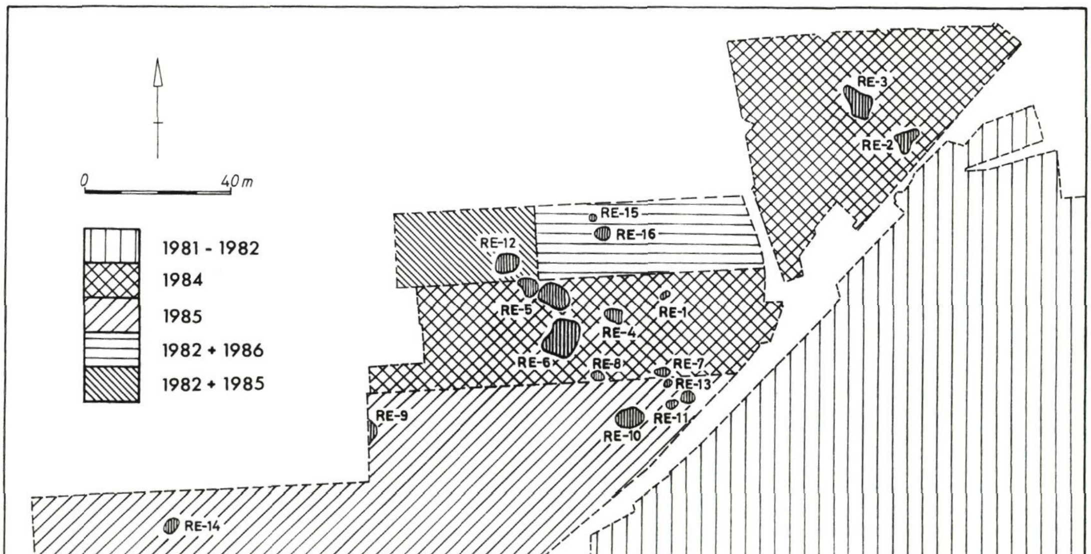
1.1 Research History

1.1.1 Research at Rekem

The fertile stretch of land on the left bank of the river Meuse at Neerharen-Rekem has been a beneficial place for settlement throughout the prehistoric, protohistoric and historic periods. The presence of Gallo-Roman buildings at this site had already been surveyed and reported in the nineteenth century[1]. Following small-scale excavations in 1955 and 1956[2], the area was extensively explored over some 40,000 sq m in the late 1970's and early 1980's by the former Belgian *Nationale Dienst voor Opgravingen* (National Service for Archaeological Excavations), succeeded by the present *Instituut voor het Archeologisch Patrimonium* (Institute for the Archaeological Heritage) of Flanders. During this fieldwork, repeated human occupation could be attested from the Late Palaeolithic to the early Middle Ages[3]. This included extensive Late Bronze age and Early Iron age Urnfields, Middle Iron age and Early Roman settlements, a Roman villa with related buildings, a late 4th to early 5th century Germanic settlement, and indications of Merovingian and 11th/12th century habitation.

Research at the *Federmesser* site started in 1984 (Aug. 1 - Oct. 31) and quickly evolved to a large-scale project with additional field seasons in 1985 (July 1 - Dec. 31) and 1986 (July 15 - Sept. 11; fig. 1). The excavations were expertly directed by Robert Lauwers[4] and were made possible thanks to close collaboration between the *Laboratorium voor Prehistorie* of the *Katholieke Universiteit* te *Leuven* and the former Belgian *Nationale Dienst voor Opgravingen* (National Service for Archaeological Excavations). On the whole, fieldwork lasted for approximately 45 weeks and employed, on average, 5-8 people (workmen and students).

1 Van Neuss & Bamps 1888.
2 Vanderhoeven 1958.
3 Thyssen & Van Impe 1979; Van Impe 1980; De Boe 1981, 1982, 1983a, 1983b, 1983c, 1985, 1986; Lauwers & Vermeersch 1982; De Boe, De Bie & Van Impe 1992.
4 Lauwers 1985a, 1985b, 1986.



1 *Rekem. Map of the areas investigated during the various field seasons at the* Federmesser *site (1984-1986; 1981-1982 refers to earlier excavations on the Protohistoric/Gallo-Roman site).*

In the same period, and until the beginning of 1988, R. Lauwers also started laboratory analyses (refitting, microwear, dating, mapping[5], etc.) and designed the general research strategy of the whole project which was conceived as a Ph.D. program. Unfortunately the lack of funding and poor employment prospects urged the excavator to abandon archaeological research.

Having participated in the excavations, one of the authors (M. De Bie) was asked to continue the project as a Ph.D. student at the *Katholieke Universiteit* te *Leuven*. As of 1992, he could proceed as an archaeologist of the *Instituut voor het Archeologisch Patrimonium van de Vlaamse Gemeenschap* while being based at the *Laboratorium voor Prehistorie* in Leuven. In 1991, J.-P. Caspar joined the project as a research fellow of the K.U.Leuven. Research has since then been conducted in full collaboration[6].

1.1.2 Finds

Except for the unique presence of resin on a projectile point, and the occasional appearance of (mainly intrusive) charcoal, the Palaeolithic finds at Rekem are exclusively lithic and mineral materials (in all, about 350 kg.). The excavated assemblage was quickly recognised as belonging to the *Federmesser* groups, initially referred to as 'Tjongerian'[7].

In terms of weight, the non-flint rocks represent the most important category (some 270 kg.). This group, further referred to as 'rocks', mainly consisted of sandstone blocks, quartzites and quartzes. Though microwear analysis has not been attempted on this material, several pieces may be interpreted as tools, employed for different tasks, and are discussed in chapter 3. This chapter will also consider the ochre remains. However, the rocks were also used as structural elements (*e.g.* in hearths and dwellings) and therefore constitute an essential framework in the spatial analyses of chapter 6.

The bulk of the material in quantitative terms consists of flint artefacts. In all, almost 24,000 pieces were counted at the various loci, all typical of a *Federmesser* context. Chapters 4 and 5 will consider this material in detail and discuss the processes of both flint knapping (*i.e.* blank production or debitage) and blank consumption (*i.e.* tool manufacture, use, maintenance, and discard). These chapters should provide a sound reconstruction of the complete *chaîne opératoire* at the site, all while presenting the distinctive typological, technological, lithological and functional features of the various assemblages.

1.1.3 From "*Tjongerian*" to "*Federmesser*"

Up until the last decade, the *Federmesser* occupation in the Belgian lowlands was known as the 'Tjongerian'[8]. This term was first introduced by A. Bohmers[9] with reference to the valley of the river Tjonger in Friesland in the Netherlands. In the 1930's, H. Popping[10] excavated some of the most important sites in this valley (Prandinge, Donkerbroek, Makkinga). In Bohmers' original concept, the '*Tjongergroep*' was defined by its lithic industry containing curved backed points and short endscrapers. This group would have occupied a major part of the NW European Lowlands. In his landmark publication on the *Federmessergruppen*[11], Schwabedissen[12] borrowed this same term, but restricted the geographical extension of his '*Tjongergruppe*' to a part of the Netherlands and, specifically, Belgium. Most other sites, including the aforementioned settlements in the Tjonger valley, were classified in the '*Rissener Gruppe*'. The distinction between both groups was based on very poor typological criteria and was not at all clear-cut. It took, however, two decades before the justification of Schwabedissen's subdivision was reviewed and profoundly criticised[13]. Since then, the more general term '*Federmesser(gruppen)*' has gradually[14] become the common term used among researchers of the NW European Late Palaeolithic[15], although the older term 'Azilian', used for related industries of SW Europe, or the broad expression 'Arch Backed Piece Complex' have also been proposed[16]. Nevertheless, even if this terminological debate has not yet been fully settled, it is clear that the label '*Tjongerian*' is not well-defined and we suggest its use should therefore be discouraged.

This does not imply, however, that the *Federmesser* assemblages in the NW European lowlands are completely uniform. 'Tanged' scrapers, for instance, seem to be an exclusive and recurring characteristic of the so-called Wehlen facies in Northern Germany[17]. Hitherto, however, none of the attempts at elaborating a significant regional division has, in our opinion, been satisfactory. Overall techno-typological resemblance appears to characterise these industries, which cover a very large area. Regional differences seem reduced and may to a certain degree also be ascribed to raw material constraints (*e.g.* metrical dif-

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5 Lauwers 1988.

6 Section 1.4; De Bie & Caspar 1993, 1997, 1998; Caspar & De Bie 1996, in press.

7 Lauwers 1984; see also section 1.1.3.

8 Van Noten 1967; Vermeersch 1984; Lauwers 1988.

9 Bohmers 1947.

10 Popping 1933, 1934. In fact, Popping should be credited for his recognition of the 'new prehistoric culture', which he called the '*Kuindercultuur*', after the Dutch name for the river Tjonger (Popping 1934). Bohmers just replaced it by the Friesian name, officially because '*Kuinder*' would have been difficult to pronounce in foreign languages or because it could have been confused with the North European Neolithic Kunda culture (Bohmers 1947, 181). On the other hand, it is known that Bohmers was profoundly attached to his Friesian mother language (van der Lee 1997).

11 In an earlier publication, Schwabedissen (1944) had proposed to use the name '*Lüneburgergruppe*', after the Luneburg Heath, where the site of Whelen had been discovered in 1880.

12 Schwabedissen 1954.

13 Paddaya 1971.

14 An historical review of this conceptual evolution is presented in De Bie 1988.

15 Cf. recent articles in *Bulletin de la Société Préhistorique Française* 94, 3 (1997), and in Fagnart & Thevenin 1997.

16 Bolus 1992; Schild 1984; Caspar & De Bie 1996.

17 Veil & Breest 1997.

ferences between sites in northern France and in the Neuwied Basin). After the Magdalenian in the Bølling, with the continued existence of regional varieties (Creswellian, Hamburgian), the Allerød Interstadial seems to have fostered a technocomplex with considerable similarities all over Western (and partly Central) Europe. In view of the huge areas potentially inhabited by hunter-gatherers, this should not be a surprise but it remains to be established whether this material concurrence truly reflects intensified contacts between highly mobile hunter-gatherer groups which eventually resulted in a very 'homogeneous' Palaeolithic society. In fact, the lack of any significant divergence among the lithic inventories might partly be an effect of the so-called 'Azilianisation', a process of technological change, characterised by an overall 'simplification' of the lithic technology and an impoverishment in tool type variety. Part of this publication will be explicitly devoted to the significance of variability in the lithic industry, as observed at Rekem.

At the time of Rekem's discovery, (published) evidence for the *Federmesser* groups in the NW European lowlands was still largely based on old excavations or surface collections, often lacking any form of stratigraphic data. Investigations in Germany and the Netherlands had occasionally correlated the industry with the Alleröd Usselo soil[18], but none of the sites had been thoroughly analysed. The chronological position of the '*Tjongerian*' in Flanders remained unsettled, and documentation exclusively consisted of surface collections or partly excavated sites[19]. Research at Meer stood out for its new methodological approach, combining detailed artefact recording with refitting and microwear analysis[20]. However, partial destruction of the site, and a possible admixture of Mesolithic artefacts inhibited the full benefit of this approach. Moreover, ^{14}C dating at Meer II further obscured the chronological problem, rather than contributing to its clarification.

The lack of systematic large-scale excavations in general, instigated the perception that *Federmesser* sites were either (small) isolated concentrations[21], or else vast areas of spread artefacts – the latter exposed in large surface collections[22]. A good account of NW European Late Palaeolithic research at the end of the eighties, is compiled in *De la Loire à l'Oder*[23], with contributions by authors from all over NW Europe. Except for the reporting of the research at Rekem[24], the publication of the typological inventory of Meer IV[25], a volume on the somewhat enigmatic site of Haule V[26], and a review of the ^{14}C-chronology[27], no major publications on the *Federmesser* occupation in Benelux have appeared since.

In neighbouring regions, especially in Northern France, the Paris Basin, and the Neuwied basin, large-scale excavations and detailed analyses during the past decade have revealed extensive areas of occupation, often consisting of various artefact loci situated on a single level[28]. Elaborate stratigraphical and chronological research in France moreover established a diachronic succession in the *Federmesser* assemblages and revealed a continuous technological change, obviously developed from Magdalenian lithic technology[29]. Several good syntheses of the present knowledge of the Late Glacial occupation in the German Rhineland, Northern France, and Great-Britain have been published recently[30]. An overview of recent Late Palaeolithic research in Benelux[31] is presented in section 1.2.

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18 *e.g.* at Rissen, Usselo, Milheeze-Hutseberg, Tilburg-Kraaiven, Westerhoven, Drunen, Bakel-De Rips, Siegerswoude II, Teltwisch: Schwabedissen 1957; Heesters & Wouters 1970; Verhagen 1979; Janssen 1980; Van Geel, Coope & Van der Hammen 1988; Arts 1988.

19 Vermeersch 1984.

20 Van Noten 1978; Cahen *et al.* 1979; see section 1.3.

21 Kind 1985; Houtsma *et al.* 1996.

22 Arts 1988; Deeben 1988.

23 Otte 1988.

24 De Bie & Caspar 1993, 1997; Caspar & De Bie 1996; De Bie 1997a.

25 Otte 1994.

26 Houtsma *et al.* 1996; see review in De Bie 1997b.

27 Lanting & Van Der Plicht 1996.

28 Bolus 1992; Bodu 1995; Coudret 1997; Fagnart 1997; Baales 1998.

29 Schwabedissen 1954 had already hinted at a link with the Magdalenian, but his arguments were partly based on inaccurate information (*e.g.* the presence of *Federmesser* in the Magdalenian site of Andernach, which later appeared to be a mixture of two industries; Veil 1982).

30 *e.g.* Bosinski, Street & Baales 1995; Baales & Street 1996; Street 1997, 1998; Valentin 1995; Fagnart 1997; Rozoy 1998; Barton & Roberts 1996.

31 Largely an update of De Bie & Vermeersch 1998.

1.2 Chrono-cultural context: Late Palaeolithic in the Benelux

1.2.1 Landscape, palaeoecology and radiometric dating

The present territory of Benelux contains an aggregate of different landscapes. Rekem is situated on the southern part of the sandy lowland plain of the Netherlands and Flanders. This plain can be subdivided into areas to the north and south-west of the rivers Rhine and Meuse. On this landscape, exclusively open-air sites are found. Although sea level was rising during this period, this part of Benelux remained connected with the British Isles throughout the Pleistocene-Holocene transition[32]. At the time of writing, sites (except for isolated finds of worked bone and antler dredged up by fishing boats) from the present North Sea floor are unknown. The southern part of Benelux (Wallonia and Luxembourg) is mainly an upland area with many cave sites. The loess area in central Belgium and in part of Limburg in the Netherlands, is situated between both parts. For each of these areas, current views on the Late Glacial and Early Holocene human occupations are somewhat different.

In a review of Late Palaeolithic radiocarbon evidence, Lanting and Van Der Plicht[33] proposed the following general chronology for the Late Glacial biostratigraphical zones in the Netherlands:

	^{14}C dates	Calibrated
Beginning of Preboreal	ca. 10150 BP	ca. 9600 cal BC
Beginning of Dryas 3	ca. 10800 BP	ca. 10950 cal BC
Beginning of Allerød	ca. 11800 BP	ca. 12050 cal BC
Beginning of Dryas 2	ca. 12000 BP	ca. 12150 cal BC
Beginning of Bølling s.s.	ca. 12500/12400 BP	ca. 12550 cal BC
Beginning of Bølling s.l.	ca. 12800 BP	ca. 12750 cal BC

The Bølling interstadial involved a climatic amelioration, but as the climate remained continental in type, the environment consisted mainly of open biotopes with herb-rich grasslands. However, local conditions seemingly provided very rich and diverse micro-biotopes. At the Magdalenian site of Chaleux[36], the Bølling fauna would have been characterised by the predominance of horse (*Equus ferus*) and the scarceness of reindeer (*Rangifer tarandus*). However red deer (*Cervus elaphus*), bovids (*Bos sp.* and *Ovibos moschatus*), caprids (*Rupicapra rupicapra* and *Capra ibex*), brown bear (*Ursus arctos*), hare (*Lepus* sp.) and several other animals were also present. Reindeer, musk ox and other cold or even arctic species, but associated with more temperate taxa, are significant at the Bølling-age Bois Laiterie Cave[37].

In the course of the Allerød, biotopes in Benelux were still open but woodlands appeared and increased. In most Dutch Late-Glacial pollen diagrams, the immigration of pine occurs in the second part of this Interstadial, i.e. between 11.4 and 11.2 ka BP[38]. In the Ardennes, according to the biozonation at Le Trou Jadot[39], the Allerød can locally be subdivided into three phases due to the existence of a temporary climatic deterioration which is characterised by a small peak in lemmings (especially *Lemmus lemmus*) and by a tendency towards drought. No large mammal fauna dating to this interstadial has yet been discovered in Benelux[40].

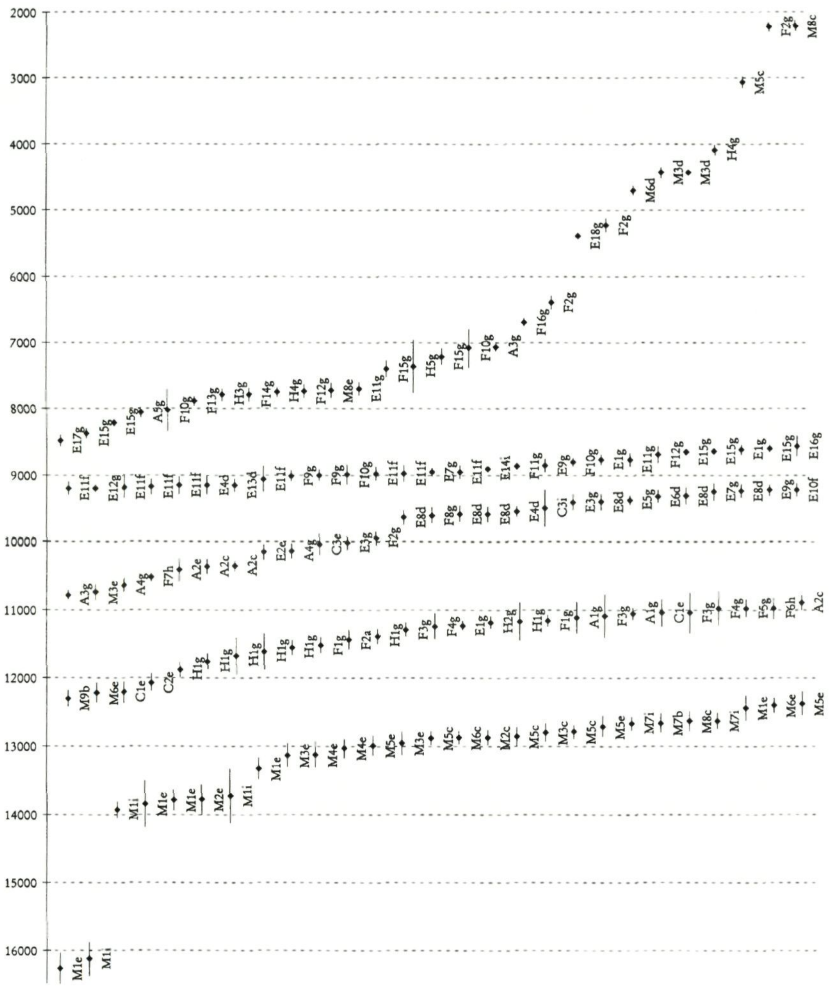
During the early Preboreal, reindeer (*Rangifer tarandus*) gradually disappeared from the area, and herbivores such as horse (*Equus ferus*) and most bovids, quickly decreased in number. As the onset of the Holocene was still cool and wet, some grasslands probably survived. However after 10,000 BP, the climate and fauna rapidly approached modern conditions[41] with the larger mammals dominated by red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), and wild boar (*Sus scrofa*).

In Benelux, absolute dates that are unquestionably associated with Late Glacial or Early Postglacial archaeological assemblages are relatively scarce (fig. 2). The AMS-dates obtained on antler artefacts, or animal bones with clear human cut marks[42], along with the date on resin adhering to a curved backed point from Rekem (section 2.3.3.1), are the only absolute dates for which the archaeological association

Evidence for the changes in the Late Glacial and Early Postglacial environment in the study area is still mainly provided by pollen analyses. Bio-stratigraphical sequences have long been examined and dated. However, in the southern Netherlands, it was shown that pollen assemblages defined on the basis of *Betula*, *Pinus*, *Corylus*, *Ulmus* and the non-arboreal taxa (the usual criteria for establishing the Blytt/Sernander scheme of zones in Late- and Postglacial pollen diagrams) are diachronous[34]. Even for nearby sites, similar events in pollen diagrams did not necessarily occur absolutely simultaneously. Generally, changes in the uplands occurred a few hundred years later than in the valleys.

In Belgium, additional paleo-ecological information, based on mammal studies, is only available for cave sites. During the stadial periods (Dryas 1, Dryas 2, and Dryas 3), the occurrence of reindeer and collared lemmings *(Discrostonyx gulielmi)* indicates a clear increase in a tundra-like environment[35].

32 Coles 1998.
33 Lanting & Van Der Plicht 1996.
34 Van Leeuwaarden 1982.
35 Cordy 1984; Cordy & Toussaint 1993.
36 Otte 1994; Charles 1994.
37 Otte *et al.* 1995; A. Gautier *in litteris* to L. G. Straus 1996; Otte & Straus 1997.
38 Bohncke *et al.* 1993.
39 Cordy & Toussaint 1993.
40 Some evidence from Northern France and Western Germany is briefly presented in section 2.4.
41 Cordy 1991.
42 Charles 1996.
43 Crombé & Van Strydonck 1994.
44 Jadin & Carpentier 1994; Cauwe 1995.
45 Becker & Kromer 1991.
46 Bard *et al.* 1993.



2 *Uncalibrated radiocarbon dates (BP, one standard error) of samples originally submitted as 'likely associated with Late Upper Palaeolithic or Early Mesolithic assemblages' in Benelux. Explanation of code:*
First character = cultural ascription:
M=Magdalenian, C=Creswellian, H=Hamburgian, F=Federmesser, A= Ahrensburgian, E=Early Mesolithic;
Last character = nature of submitted sample:
a=resin on artefact, b=bone/antler artefact, c=humanly modified bone/antler, d=human bone, e=unmodified bone/antler or bulk sample, f=burnt hazelnut shells, g=charcoal, h=peat, i=unkown to the authors;
Sites:
M1=Trou des Blaireaux, Vaucelles; M2=Trou des Nutons (=Grotte de Sy Verlaine), Verlaine; M3=Trou du Frontal, Furfooz; M4=Trou Walou, Trooz; M5= Trou de Chaleux, Hulsonniaux; M6=Grotte du Coléoptère, Bomal-sur-Ourthe; M7=Bois Laiterie, Profondeville; M8=Trou des Nutons, Furfooz; M9=Trou da Somme, Waulsort; M10=Orp West; M11=Orp East; C1=Presle; C2=Chauveau, Yvoir/Godinne; C3=Trou Walou, Trooz; H1=Oldeholtwolde; H2=Duurswoude II; H3='t Ronde, Elsloo; H4=Luttenberg; H5=Donderen; F1=Budel II; F2=Rekem; F3=Hornhaelen; F4=Duurswoude I; F5=Milheeze I; F6=Usselo; F7=Schipsloot, Een; F8=De Banen, Nederweert; F9=Meer I; F10=Meer II; F11=Hooidijk, Eext; F12=De Waag, Achel; F13=Eindegoorheide, Weelde; F14=Fabriek, Lommel; F15=Sonnisse Heide I, Helchteren; F16=Oirschot VII; F17=Meer IV; A1=Geldrop I; A2=Grotte de Remouchamps; A3=Molenheide, Zonhoven; A4=Mie Peels, Geldrop; A5=Geldrop III; E1= Vessem III, Aardhorst; E2=Trou Balleux, Hulsonniaux; E3=Luiksgestel 2; E4=Abri des Autours, Anseremme-dinant; E5=Gramsbergen; E6=Petit Ri, Malonne; E7=l'Ourlaine, Theux; E8=Grotte Margaux, Anseremme; E9=Hulshorst; E10=De Kip, Neerharen; E11= Verrebroek; E12=Havelte 2; E13=Grottes des Sarrasins, Loverval; E14=Gennep; E15=Rotsterhaule; E16=Bakelse Dijk, Milheeze; E17=Beerzer Belten 2; E18=Hazeputten I, Nijnsel; E19=Stegerveld.

cannot be questioned. For the Early Mesolithic, AMS dates of charred hazelnuts also seem acceptable[43]. Human bones of individual and collective burials have also been dated at several sites in upland Belgium to the Early Mesolithic[44] but the associated archaeological material is very poor, and hardly illustrative. In all, it should nevertheless be encouraging that all the 'reliable' dates were obtained during the last decade.

Aside from this quest for 'good' dates, we are confronted with the fact that the deviations in the ^{14}C curve are still not exactly known for most of the period under discussion. At the time of writing, a detailed terrestrial calibration curve for the Late Glacial was not yet available. The major atmospheric radiocarbon variations in the Preboreal[45], indicate that use of the uncalibrated radiometric time scale for the Late Glacial remains problematic. Calibration based on U/Th dates[46], can only offer a provisional view (fig. 3). Thermoluminescence dating for this period is also not very helpful at this point in time (fig. 3).

In conclusion, despite the considerable amount of Late Glacial and Early Postglacial research carried out in Benelux, we still face numerous problems in relating the archaeology to the environment. Sites where direct links occur are rare. The largest part of the area lacks faunal evidence, while palynological results, if available, have often proved difficult to interpret in relation to the sites. Use of the chronological evidence to relate sites indirectly with biostratigraphical models carries its own difficulties. The association of the dates appeared to be rarely unquestionable and, together with possible deviations in the ^{14}C curve, which so far are not exactly known for most of the period under discussion, the contemporaneous palynological record appears to present significant regional divergence.

1.2.2 Human occupation

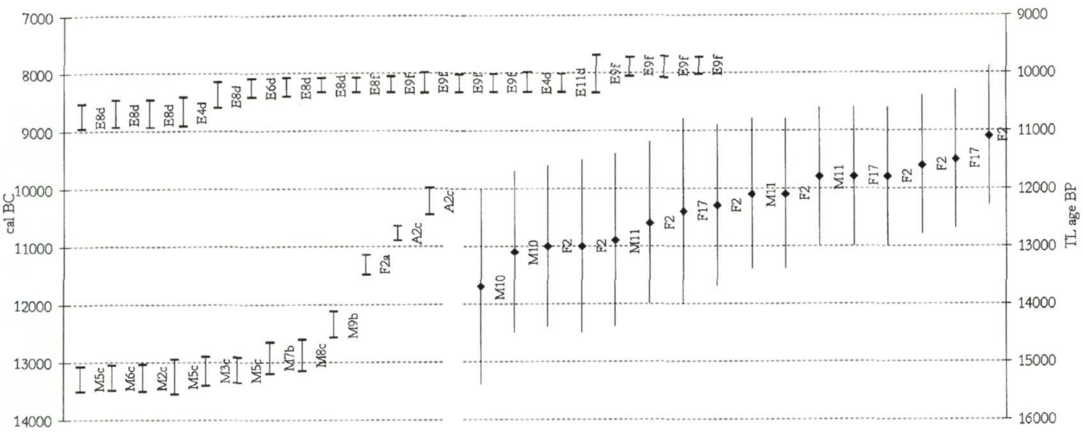
Lack of credible evidence to the contrary suggests that Benelux was unoccupied during the Last Glacial Maximum, at least until 17 ka BP, but probably until *circa* 13 ka BP. Severe (cold and dry) climatic conditions and the nearly abiotic environment were probably inappropriate for human habitation at these latitudes. In the subsequent transition towards the Holocene, the region is claimed to have been visited by Magdalenian, Hamburgian, Creswellian, *Federmesser*, Ahrensburgian and Early Mesolithic groups.

1.2.2.1 *Magdalenian*

Magdalenian presence is attested in both caves and open-air sites near the Meuse and its tributaries, in the southern part of Benelux (fig. 4).

Open-air sites have only been recognised during the last two decades and are located in the northern

3 *Left: calibrated radiocarbon dates (cal BC, one standard error) of samples of type a, b, c, d, and f (see legend of fig. 2). Calibration was based on the OxCal program, v2.18 (M. Stuiver, A. Long & R.S. Kra 1993; Bronk Ramsey 1994), using the 68.2 % confidence level, and connecting discontinuous results.*
Right: thermoluminescence dates (TL age BP, one standard error).
For identification of sites, see legend of fig. 2.



part of the Belgian loess belt (Kanne and Orp[47]) and in the loess belt of the southern Netherlands[48]: Echt; Eyserheide; Griendsveen; Steenberg, Mesch; Oude Stort, Groene Paal, and Koolweg, Sweikhuizen.

In the Belgian Meuse basin, cave sites have been explored for over a century[49]: Grotte de Chaleux, Hulsonniaux; Trou du Frontal and Trou des Nutons, Furfooz; Grotte du Coléoptère, Bomal; Grotte de Sy Verlaine, Tohogne; Grottes des Fonds-de-Fôret and Trou Walou, Trooz; Trou Dubois, Moha; Grottes de Goyet, Mozet; Trou Blaireaux, Vaucelles; Trou Magritte, Pont-à-Lesse; Trou da Somme (La Roche-al-Rue), Waulsort; Grotte du Bois Laiterie, Profondevile.

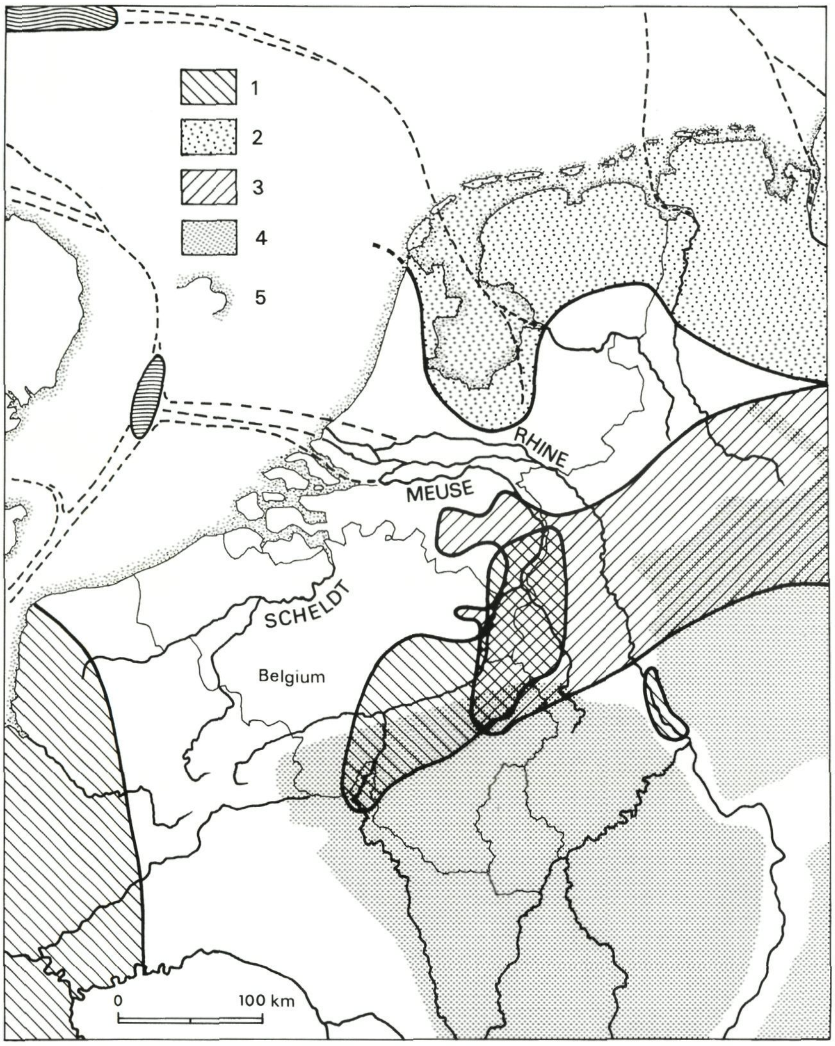
Based on conventional ^{14}C-dating, Magdalenian occupation was formerly subdivided into several phases[50]. Short pre-Bølling visits were claimed at Vaucelles, where accumulations of shed reindeer antlers, dated to around 16.2 ka BP and 13.8 ka BP, according to the excavators[51] included debitage from antler working. However, according to Charles[52], who examined a substantial part of the faunal assemblage of Vaucelles, the antlers did not appear to have been humanly modified in any way. The only specimen that at first sight showed traces of butchering, a right ulna of *Equus ferus*, dated at 13,330 ± 160 BP (OxA-4200), was also eventually brought into question, since opinions were mixed as to whether or not it was cut[53]. The only remaining ^{14}C-date that was claimed to situate Magdalenian presence well before the beginning of the Bølling s.l., namely at 13780 ± 220 BP (Lv-690), was obtained on a bulk sample of bone splinters from old excavations in the Grotte de Sy Verlaine[54]. An accelerator date on a single cut left pisiform of *Equus ferus* from the same assemblage, indicated that there was human presence significantly later: 12870 ± 110 BP (OxA-4014).

In view of these results, one may wonder whether certain open-air sites, such as Orp and Kanne, could possibly represent the earliest Magdalenian occupation in Benelux. Arguments in favour of a pre-Bølling age in this area may be found not only in techno-typological similarities with Etiolles-unit U5, dated by a series of AMS dates at 13.0-12.9 ka BP, but also in the post-depositional presence of heavy cryoturbational activity on those sites. However, the TL-dates from the site of Orp (weighted mean of 13.3 ± 1.1 ka BP at Orp West and 12.2 ± 0.8 ka BP at Orp East) seem younger than the TL-date from Etiolles (15.2 ± 1.0 ka BP) and it cannot be fully excluded that cryoturbational activity during the Late Glacial may be related to very cold Dryas 3 conditions[55]. In any case, loess sedimentation was not yet at its end and continued on these sites, even after human occupation.

At present, accelerator dates on artefacts or humanly modified bones have only confirmed Magdalenian presence in Benelux at the very beginning of the Bølling s.l. (12.9-12.6 ka BP)[56]. The duration of this presence in calendar years cannot presently be estimated, but the possibility of a plateau in the radiocarbon curve at about 12.8 ka BP can not be excluded. A single date from Trou da Somme (12,240 ± 130 BP) might suggest further human visits at the end of the Bølling, although the Magdalenian character of the artefact and the archaeological assemblage that was dated has not yet been fully established. On balance, Charles[57] convincingly argues that the Magdalenian presence in the Belgian caves may be restricted to far more limited period(s) of occupation than had formerly been envisaged[58].

Environmental studies (palynology, anthracology, faunal analyses, and malacology) have shown the Bølling Interstadial to be characterised by a generally temperate climate, where local conditions could harbour varied mesotherm species, enabling a great variety of faunal species to live in this area. Nonetheless, the uplands of the Lesse Basin landscape still mainly consisted of open spaces with a fauna adapted

47 Vermeersch *et al.* 1985, 1987.
48 Wouters 1982a, 1983; Arts & Deeben 1987; Rensink 1991, 1992.
49 For bibliographical references, consult: Dewez 1987; Charles 1994; Teheux 1994; Straus *et al.* 1995; Otte *et al.* 1995; Straus & Otte 1995.
50 Otte 1989.
51 Bellier & Cattelain 1986.
52 Charles 1994a.
53 Charles 1996.
54 Dewez 1987.
55 Vermeersch 1991.
56 Otte *et al.* 1995; Charles 1996.
57 Charles 1996.
58 Compare *e.g.* Gilot 1993; Lanting & Van Der Plicht 1996.



4 *Geographical distribution of Magdalenian (1), Hamburgian (2), and Ahrensburgian (3) sites in Benelux and adjacent countries; (4) = upland regions; (5) = present North Sea coast.*

to steppe (horses, reindeer, and bovids – including a relict population of musk oxen). Along the river, however, open forests were home to deer and brown bear, while ibex and chamois could live on the slopes, which were covered with herbs and shrubs[59]. Hunted animals include a wide range of large mammals (see above), in which horse is a major component (more than 65 % of identifiable species at Chaleux), while reindeer often occur less frequently (only 4 % at Chaleux[60]). Little is presently known about the fish component in the overall subsistence, although there are fish remains from Chaleux, Furfooz, and Bois Laiterie[61].

The climatic amelioration apparently instigated an 'explosion' of human activity in the Belgian Ardennes. In addition to hunting and subsistence activities in general, it included art production and a variety of domestic and technical practices. Magdalenian art is present in both figurative (animals) and non-figurative engravings on stone plaquettes and other portable objects including ornaments[62]. Bone and antler tools include points, needles, and a few harpoons. Lithic technology in the cave sites is marked by classic blade debitage. Cores are intensely worked and often exhausted. Tools are dominated by backed bladelets, borers/becs (including double micro-borers typical of the Meuse-Lesse region), burins (dihedral types, and burins on truncation, including the distinctive Lacan type) and end-scrapers.

As most of the sites were excavated long ago, little reliable information on dwelling structures is available. The presence of numerous slabs suggests the creation of pavements. It is suggested that the well-situated caves probably served as repeatedly occupied residential camps in different seasons of the year[63], while others may have had more limited functions[64].

The open-air sites in Benelux belong to the most northerly distribution of the Magdalenian in western Europe[65]. They are restricted to artefact accumulations within which, due to the acid soil conditions, no organic material is preserved. Some are situated near the loess plateau edge, from where there are broad panoramas. It is assumed that these locations were chosen because of the excellent opportunities they afforded for surveying the landscape and that the sites served as short-term hunting stands[66]. Unfortunately, no direct evidence for hunting activities is available. Other sites are situated near natural occurrences of good quality flint, and were mainly flint exploitation sites. Horizontal artefact distributions sometimes suggest the use of small tent-like structures[67]. However, at the time of writing, there are no firm indications of residential base camps among the Magdalenian open-air settlements in the region.

Debitage at these open-air sites is characterised by high-quality blade production, with preparation of two opposed crests and frequent abandonment of large cores. Typical butt preparation '*en éperon*' and overhang blunting is clearly present. The tools are dominated by burins, most often on truncations, including Lacan burins. The assemblages are further characterised by long blade scrapers, and in contrast to the cave facies of the Magdalenian, a scarcity of backed bladelets, borers, becs, and splintered pieces. The sites of the loess area have not yielded any artistic manifestations – even on stone.

The raw materials are mainly of local origin. However, some quartzite may have been introduced from the central Rhineland of Germany, while, on the other hand, flint from the Meuse region is well represented in most of the Magdalenian inventories of the Rhine valley[68]. This hints at possible connections of the Benelux 'open-air' Magdalenian with the well-known settlements in the Middle Rhine valley.

On balance, those elements may suggest that Magdalenian open-air occupations in Benelux were of a different type and/or belonged to other cultural traditions than those of the cave sites. It has been proposed that the latter were repeatedly occupied by Magdalenians coming from the South, whereas the open-air sites were visited by human groups that came from the German Rhine valley. The presence

59 See above, analyses by Noirel-Schutz, Schoch, Patou-Mathis, Cordy & Léotard in Otte 1994.
60 Charles 1994.
61 Otte *et al.* 1995; Straus *et al.* 1995.
62 Lejeune 1987.
63 Stutz 1993; Otte 1994.
64 Straus & Otte 1995.
65 Rensink 1993.
66 Rensink 1991.
67 Vermeersch *et al.* 1987; Arts & Deeben 1987.
68 Floss 1994; Rensink 1995.

of these groups along these northern latitudes was probably occasional and punctuated rather than continuous[69].

It is not clear why Benelux sites represent the northernmost extension of the Magdalenian. It might be related to contemporary climatic conditions along latitudes further North, but also to soil types – assuming that biotopes on the sandy soils of the northern plain could not satisfy Magdalenian subsistence needs – or to a lack of relief needed for drive-hunting[70].

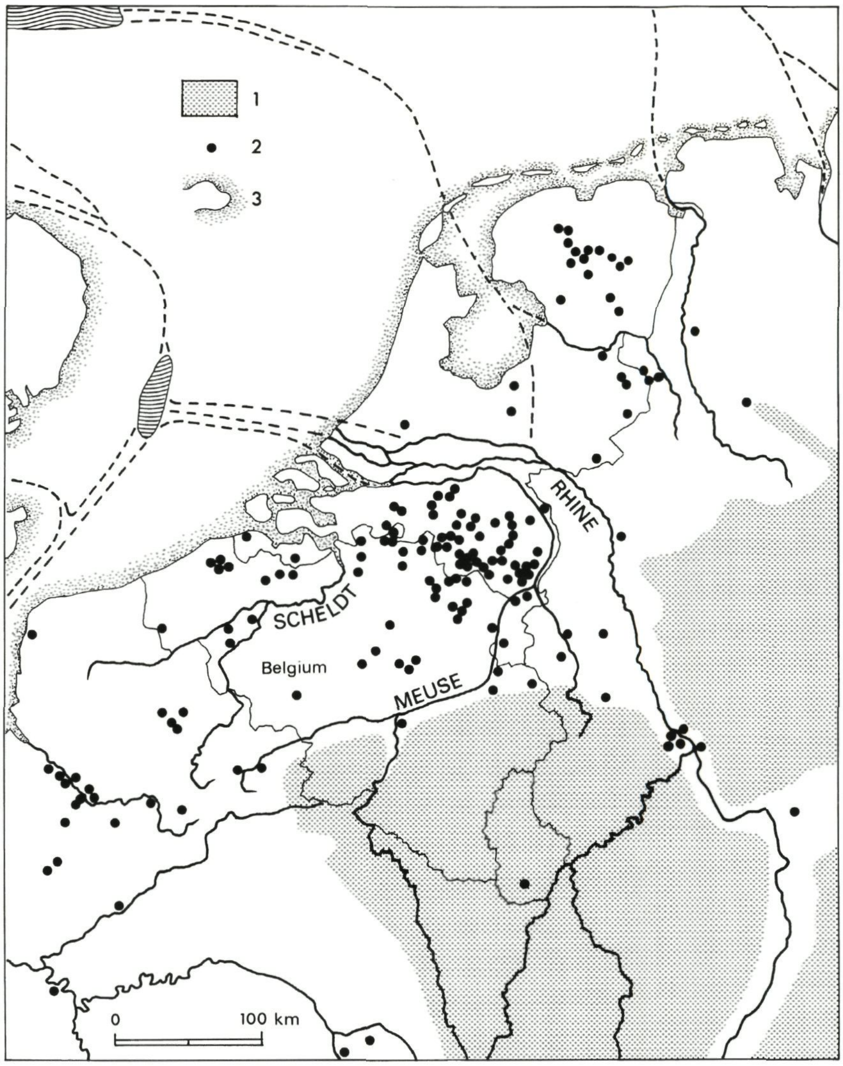
1.2.2.2 Hamburgian

The distribution of Hamburgian sites in Benelux is separated from the Magdalenian by an empty zone corresponding to the present Rhine-Meuse area (fig. 4). Some of the important sites are: Diever; Duurswoude; Elspeet; Gasselte; Holtingerzand; Havelte; Kolderwolde; Luttenberg; Sassenhein; Oldeholtwolde; Oosterhesselen; Vledder; Rolde; Ureterp (Rensink & Stapert, n.d.). Only a few sites have been properly excavated. Most settlements are located in a coversand zone and are buried under the aeolian sands of the Final Pleistocene. Some sites are situated on pingo walls; others are on slopes near small rivers. Due to their geomorphological position, no organic materials have been preserved.

Pollen analysis outside Benelux has shown that the Hamburgian is related to the Bølling s.s.[71]. A new series of radiocarbon dates from the classic Hamburgian assemblages of the Ahrensburg Valley in Northwest Germany[72], places these sites around 12,500-12,200 BP. In the Netherlands, however, absolute dates are extremely rare, and generally 'too young' (fig. 2). Conventionally, two chronological groups can be identified in this area[73], the older of which is supposed to fit into the Bølling. However, except for a possible association of the industry at Duurswoude IV with a Bølling horizon[74], there is no unquestionable evidence for a Bølling age for the Hamburgian in the Netherlands. At Oldeholtwolde, Luttenberg, Haren-'Sassenhein', Weerselo, Texel, and Agelerbroek, the stratigraphic position of the artefacts suggests that (at least) the younger (Havelte) group is situated in Dryas 2[75]. The averaged AMS determinations on hearth charcoal at Oldeholtwolde gave a radiocarbon age of 11,650 ± 65 BP. The inconsistency of this age with the stratigraphic position of the industry, according to the excavator could be due to 'wiggles' in the ^{14}C-curves in this period[76].

According to Burdukiewicz[77], the origin of the Hamburgian may be found in the Middle Magdalenian of western and central Europe. Conversely, it has often been argued that some sites in northern France, such as Marsangy and Cepoy, attest Hamburgian influences. Part of the mixed assemblage of Obourg in southern Belgium[78] might also be attributed to this phenomenon.

Most of the sites consist of small to medium-large flint accumulations, sometimes with a central hearth[79]. Small scatters, where a single tool type is



5 *Distribution of Federmesser sites (2) in Benelux and adjacent countries; (1)=upland regions; (3)=present North Sea coast.*

predominant, suggest specific activity areas. Raw materials were collected in the local glacial deposits. The lithic technology of the Dutch Hamburgian is characterised by blade production on single- or double-platform cores. Blades are generally somewhat smaller than the Magdalenian ones (possibly due to raw material constraints) and butts *'en éperon'* are quasi-absent[80].

Kerbspitzen (shouldered points) and *Zinken* (type of borer) are most characteristic for Hamburgian assemblages, but notched pieces, borers, and points (both shouldered, tanged and some backed variants) are also common tool types. Burins and blade-scrapers (often with retouched lateral edges) are relatively less frequent. Backed bladelets, characteristic of many Magdalenian assemblages, are nearly absent in the Hamburgian. In the earlier group (type Ureterp), *Kerbspitzen* are numerous, whereas the later Havelte Group includes slender Havelte points as well as angled and curved backed elements.

69 Housley *et al.* 1997.
70 Rozoy 1998.
71 Usinger 1975.
72 Fischer & Tauber 1986.
73 Bohmers 1947.
74 Houtsma 1990.
75 Stapert 1986; Stapert & Krist 1990; Lanting & Van Der Plicht 1996.
76 See above; Stapert 1992, 17.
77 Burdukiewicz 1986.
78 Letocart 1970.
79 Stapert 1992.
80 Stapert & Krist 1990; Fagnart 1993.

Because of the poor preservation conditions, information on subsistence is still lacking in the Dutch Hamburgian, which contrasts dramatically with the very rich evidence from the German sites, where reindeer hunting provided the primary animal food resource[81].

1.2.2.3 Creswellian

In opposition to Lanting & Mook[82], we believe that there is no evidence for the Creswellian in the northern Netherlands that might be contemporaneous with late *Federmesser* and Ahrensburg occupation in the South. In fact, we are not at all convinced of the very existence in Benelux of open air sites belonging to the Creswellian as viewed by British colleagues[83], referring to the sites in Cheddar Gorge and Creswell Crags. There the Creswellian, currently dated to the 13th millennium BP, is defined as a "Young Palaeolithic technology with trapezoidal side blades and lacking microlithic backed bladelets"[84]. We agree with Jacobi that these British sites can be associated with the pre-Allerød Magdalenian (and possibly the Hamburgian), rather than with the *Federmesser* complex (see below), to which in our view most of the so-called Creswellian sites of the Netherlands (*e.g.* Emmerhout[85], Siegerswoude II[86]) can be related. Within these rather small assemblages (*e.g.* 29 tools at Emmerhout), the typical trapezoidal side blades as well as the Upper Palaeolithic blade technology (long and strongly curved blades from well prepared single-platform cores, butts '*en éperon*', etc., which are typical of both the Magdalenian on the continent and the Creswellian in Great-Britain[87]) are lacking. An assemblage which might approach the present definition of the British Creswellian was excavated at Zeyen (or Zeyerveld) in the 1940's. It has a high blade-index, several trapezoidal side blades, long and thin end-scrapers with sharp scraper angles, no curved or straight backed points, etc.[88]. Unfortunately, the site has never been published properly, and the collection is dispersed among different locations[89]. In any case, we do not approve of Stapert's proposition to define Creswellian, Hamburgian, and *Federmesser* sites purely on the majority of respective point types at a site[90]. Other (*e.g.* technological) criteria should certainly also be taken into account.

As for the so-called Creswellian open-air sites south-west of the Meuse[91], we have even more doubts than in the cases noted above. Assemblages can have various backed forms, including angled backs (see above), but are never dominated by the very specific trapezoid forms described in the British Creswellian[92]. Moreover, these so-called 'Creswellian'[93] open-air sites are either surface collections (Orroir[94] and Maldegem[95], or mixed assemblages (Obourg[96]) and none are dated properly.

Most of the assemblages in the Belgian cave sites that have been ascribed to the Creswellian also do not have the characteristics currently defined for the British Creswellian. The cave site of Martinrive at Aywaille[97] should, in our view, clearly be associated with the *Federmesser* industries (see below). The cultural ascription of the Bois de la Saute at Haut-le-Wastia[98], the 4th grotte d'Engis[99], the Abri de Mégarnie[100] and the Trou Jadot at Comblain-au-Pont[101] is in all cases difficult, as hardly any diagnostic tools have been collected at these sites. Other (poor) assemblages excavated in the Trou Héron at Comblain-au-Pont, in the Hout-si-Plout cave at Neupré and in the Trou Walou at Trooz[102] are still virtually unpublished.

That leaves the caves at Presle[103] and possibly the recently excavated 'Chauveau' rock shelter at Yvoir/Godinne[104] as the best candidates for the 'Creswellian' label. However, if the British definition is accepted, there is not much reason for such an attribution here either. At Presle, points are dominated by curved backed variants; clear trapezoidal side blades are extremely rare, and in opposition to Barton's view[105], there is a considerable number of straight backed bladelets, as well as some Lacan burins.

Provided they represent a single industry, the Presle assemblages could also be compared with final Magdalenian sites with so-called 'Nordic' elements (except for the borers; Schmider, n.d.). It is of course conceivable that these in turn were influenced by the British Creswellian (and/or Hamburgian; see above), possibly in the course of a 'retreat' during the Bølling-Dryas 2 transition, shortly before 12,000 BP, or that the changing environment invited Late Magdalenian hunters to adopt a new strategy and use armatures similar to the ones that were being employed along more northern latitudes during the Bølling s.s. That would be consistent with the provisional chronological position of Presle (with a conventional date at 12,140 ± 160 BP: Lv-1472), Chauveau (with a conventional date at 12,000 ± 130 BP: Lv-1961), and Marsangy (with an AMS date at 12,120 ± 200 BP: OxA-740).

However, taking into account the second date at Presle (10,950 ± 200 BP: OxA-1472), we may very well be dealing with mixed assemblages there, including a later *Federmesser* occupation. Sadly, the date was on an unmodified mandible of red deer, and further attempts at AMS- dating here have proved unsuccessful so far, the selected specimens having been treated with an unknown organic preservative[106].

Facing the major problems surrounding the identification of a 'Creswellian' in Benelux, it seems wiser for the moment not to attempt any further discussion of possible adaptive strategies that these (hypothetical) groups might have introduced during the Pleistocene-Holocene transition. This is unfortunate, as they may have played a crucial role in the development of the subsequent *Federmesser* industries, together with the sites just mentioned from northern France and Germany.

1.2.2.4 Federmesser

During the Allerød interstadial, *Federmesser* groups (Arched Backed Piece complex[107]) spread all over the

81 Bokelmann 1991.
82 Lanting & Mook 1977, 22.
83 Jacobi 1991, 1997; Barton 1992; Barton & Roberts 1996.
84 Jacobi 1991, 138.
85 Stapert 1985.
86 Kramer *et al.* 1985.
87 Jacobi 1997.
88 Bohmers 1956, 23-24; Paddaya 1971, 265-266.
89 Wouters 1982b, 122-130.
90 Stapert 1985, 54.
91 Claimed for instance by Otte 1984.
92 Jacobi 1991.
93 Otte 1984, 174.
94 Otte 1979.
95 Otte *et al.* 1984.
96 Letocart 1970.
97 Dewez 1977.
98 Toussaint *et al.* 1979.
99 Dewez 1987.
100 Dewez 1987.
101 Toussaint *et al.* 1993.
102 Dewez 1992.
103 Danthine 1960; Léotard 1985; Dewez 1987; Léotard & Otte 1988.
104 Toussaint & Becker 1993.
105 Barton 1992, 191.
106 Charles 1994.
107 Schild 1984.

Benelux region, though they are best known in the sandy areas of the lowlands (fig. 5). In the southern uplands, the picture of the *Federmesser* occupation is less clear. Cave sites were probably visited less intensely. The above mentioned site of Martinrive, as well as some of the formerly called 'Creswellian' assemblages, likely represent the cave variety of the *Federmesser* sites. In Luxembourg, a *Federmesser* presence has also been recognised, but so far only from isolated finds[108].

We have already suggested that 'early' sites with backed points in northern France and southern Germany may represent a base from which began the northward spread of the *Federmesser* groups. In this regard, *Federmesser* assemblages with 'Creswellian-like' features from the lowlands (see above) could indeed represent the early stages of the occupation, but dates to support this hypothesis are currently unavailable. Other predecessors might be found in northern Late Hamburgian sites, certainly if a Dryas 2 age (or later) of some of these assemblages could be confirmed (see above). Good arguments for a certain affiliation are, in our opinion, not only presented by the various backed pieces from the Late Hamburgian, but also by the end-scrapers with retouched edges (which are also present in both the 'Creswellian-like' *Federmesser* sites[109] and the *Federmesser* sites of the so-called Wehlen-facies[110]) as well as by the general flint technology. In any case, and in view of the current chronology, the industries with shouldered and angled backed points play a crucial role in linking the Late Magdalenian and the *Federmesser* occupation of Benelux. If they (re-)introduced bow-and-arrow hunting technique in Northwest Europe[111], clearly the *Federmesser* occupants already heavily relied on this weapon[112].

Of primary importance to the question of the origin of the *Federmesser* groups is of course the exact age of the *Federmesser* appearance in Benelux. In view of possible post-depositional vertical displacement, a presence of artefacts some 20 cm below the Usselo soil (*e.g.* at Duurswoude-Oud Leger[113]) provides very little proof of a pre-Allerød age. Radiocarbon dates referring to just before or to the beginning of the Allerød interstadial are currently absent in Benelux. Such dates were, however, obtained elsewhere, at *Federmesser* sites in Germany and in France; for instance at Klein-Nordende (2 dates with a pooled value of 12,010 ± 75 BP), at Martinsberg, Andernach (4 dates with a pooled value of 11,960 ± 81 BP), at Westerkappeln C (KI-271: 11,800 ± 300 BP), at Varennes-lès-Macon (Ly-849: 11,850 ±, 190 BP), at Pincevent, level III (OxA-391: 11,870 ± 130 BP) and at Le Closeau, Rueil-Malmaison, lower level (12,090 ± 90 BP)[114].

The 30 radiocarbon dates presently available in Benelux do not clarify the chronological position of the *Federmesser* occupation (fig. 2). Problems related to charcoal dating in sand deposits have been reviewed above[115]. Specifically for the *Federmesser* sites, an additional problem is the presence of 'natural' charcoal in the Usselo soil of Allerød age.

Currently, the only date which can be claimed to date a *Federmesser* assemblage with any certainty is that from the resin on a curved backed point found at Rekem (OxA-942: 11,350 ± 150 BP). A late glacial age was here confirmed by the TL dates, while all dates on charcoal are post-glacial[116] (section 2.3.3; fig. 2 and fig. 3).

We are not in favour of propositions that place *Federmesser* occupations in the Preboreal, or even beyond, and which accept a cohabitation with the Early Mesolithic, or a continuous tradition evolving into the Mesolithic[117]. In fact, only dates from Rekem, Meer II, and De Banen, Nederweert lie in the Preboreal, whereas a whole series of dates is of even more recent age.

There are similarly no irrefutable arguments in support of a continuation of the *Federmesser* tradition into Dryas 3[118]. The single date of this age in Benelux (at Schipsloot, Een: 10,495 ± 60 BP, GrN-6341) was explicitly considered as a *terminus ante quem* and was not associated with the industry[119]. Evidence for a post-Allerød stratigraphical position is never free of doubts[120] since the presumed underlying 'Usselo soil' was never characteristic (*e.g.* lacking charcoal). Previous claims that *Federmesser* sites had been found in indisputable Dryas 3 deposits at Haule V and Siegerswoude II[121] are not confirmed in the respective final publications[122]. Furthermore, we are not convinced by the recent suggestion[123] that the repeated vegetation changes observed in the pollen diagrams from lake deposits of Dryas 3 age at Milheeze may be ascribed to the localised impact of *Federmesser* settlements. In fact, according to the profiles[124], the *Federmesser* artefacts at Milheeze Ib were essentially situated under the gyttja deposits. Moreover, the relevance in comparing the impact on vegetation by recent Saami villages (in use for some years) with that caused by short-term *Federmesser* camps can be seriously questioned[125]. Therefore, as far as Benelux is concerned, and until proven otherwise, we would like to advocate the traditional assumption that the

108 Spier & Le Brun-Ricalens 1994; Spier 1997.
109 Stapert 1985.
110 Schwabedissen 1954; Veil & Breest 1997.
111 Bosinski 1987, 131; but see Bokelmann 1991, 79.
112 Caspar & De Bie 1996.
113 Bohmers & Houtsma 1961.
114 Street *et al.* 1994; Bokelmann *et al.* 1983; Günther 1973; Combier & Floss 1994; Rensink 1993; Bodu 1995.
115 Housley 1991; Vermeersch 1999.
116 De Bie 1997a.
117 cf. Lanting & Mook 1977, 23; Van Noten 1978, 56; Rozoy 1978; Otte 1984, 176.
118 Pace Deeben 1995.
119 Houtsma *et al.* 1981, 72.
120 Vermeersch 1977; Verbeek 1994.
121 Newell 1973, 429, note 4; Lanting & Mook 1977, 22.
122 Kramer *et al.* 1985; Houtsma *et al.* 1996.
123 By Bos & Janssen 1996.
124 Shown in Arts 1988.
125 Bos & Janssen 1996, 736.

Federmesser occupation is strictly connected with improved environmental conditions during the Allerød Interstadial.

The reason for the presumed disappearance of the *Federmesser* groups from the area is as yet unclear but might be sought in the sudden start of the Dryas 3 stadial[126]. It is difficult to asses the impact on nomadic hunter-gatherers of a rapid, disastrous climatic change, combined with presumed forest fires at the end of the Allerød, and partly, maybe, with influences of the volcanic activity in the Neuwied basin of West-Central Germany[127]. We do not necessarily have to argue for mass deaths, but few parallels are known for the sort of reaction that nomadic people would have to an already burned, deserted environment, that, with the advent of Dryas 3, would change even more dramatically. Could it be that these groups indeed went south, where authors agree that the *Federmesser* occupation in the upland regions, and the Azilian, a comparable variant of the Arched Backed Piece Complex, did continue in Dryas 3[128] or even later[129]? It has been noted[130] that as a whole, the dated Azilian deposits in the southern sector seem to cluster more tightly in the later time range than the more northerly sites. In any case, at some Azilian sites, ^{14}C data are consistent with the Dryas 3 pollen and sedimentological data. This is so far not the case in Benelux.

Federmesser settlements in the Dutch and Belgian Lowlands are often situated on continental dunes or coversand ridges near open water and have varied dimensions. Hearths have been recognised but are generally poorly preserved. No organic materials survive. Lithic raw materials used by the *Federmesser* groups in the southern part of Benelux often include a type of black flint of Obourg quality that is generally not locally present. However, local flint occurrences were also largely exploited. We are not convinced that (part of) the site at Waubach represents a specific quarry site of the *Federmessergruppen*[131]. Despite former claims[132], there is also no clear evidence that *Federmesser* knappers exploited Wommersom Quartzite.

Debitage is generally characterised by a simple blade technology (see chapter 4), that can be clearly distinguished from Magdalenian debitage. Tool frequencies seem to vary from site to site. Careful analysis of large settlements such as Meer[133] and Rekem (this volume) has shown that these differences originate in the differential use of intra-site areas. Lateral modified (backed) pieces, burins, and end-scrapers are the best represented tool types. Points most often have a curved back (Tjonger points), but angled backs are also found. Burins on truncation are generally more numerous than dihedral burins and where careful analysis has been undertaken, the Lacan burin technique (truncation posterior to the production of the burin spall) can normally be found on these sites.

There is currently no evidence of stratified *Federmesser* layers in Benelux and, as stated earlier, the absolute chronology is far from established. Recent evidence from stratified sites in northern France (Hangest-sur-Somme III.1[134] & Le Closeau, Rueil-Malmaison[135]) and of technological and stylistic variability associated with the different layers, should instigate a re-evaluation of *Federmesser* assemblages in Benelux. In general terms, however, a major degree of uniformity appears to characterise these industries.

1.2.2.5 Ahrensburgian

In comparison with the *Federmesser* occupation, the Ahrensburgian in Benelux is geographically much more restricted (fig. 4). Until recently, open-air sites of the Ahrensburgian were only known from Noord-Brabant and Limburg in the Netherlands[136]. With the excavations at Molenheide 2, Zonhoven (Peleman *et al.* 1994), however, the presence of the Ahrensburgian in Flanders is now confirmed, as former claims (*e.g.* Heide, Lommel[137]) came from mixed surface collections and remained unpublished. The Ahrensburgian is largely unknown in the northern part of the Netherlands, although a few recent finds in this region may also indicate sporadic (epi?) Ahrensburgian visits[138]. In the Belgian uplands, the Ahrensburgian is present in several caves (Grotte du Coléoptère, Fonds-de-Fôret, Grotte de la Préalle, Remouchamps[139]). The restricted distribution of Ahrensburgian sites in a spatially discrete territory has motivated some authors to suggest that they may have belonged to the same settlement system[140].

Despite the aforementioned problems related to charcoal-derived ^{14}C-determinations from the open-air sites, most of the Ahrensburgian dates are situated in the 11th millennium BP (fig. 2). Three Remouchamps dates overlap with a date from reindeer antler from Stellmoor (Y-159-2: 10,320 ± 250 BP). A new series of dates at this classic site in Germany appears to cluster round 10,000 BP[141] and it has therefore been suggested that this 'classical' Ahrensburgian site is better placed at the very beginning of the Preboreal[142]. The fourth date from Remouchamps (on modified bone; OxA-4191: 10,800 ± 110 BP) is significantly older, suggesting recurrent occupation in this cave, although the precise shape of the 14C-curve in Dryas 3 is unknown at present. If truly representative, it would indicate – supported by the older dates of Geldrop I (GrN-1059: 10,960 ± 85 BP), Molenheide 2, Zonhoven (UtC-3720: 10,760 ± 70 BP), and Mie Peels, Geldrop (OxA-2563: 10,610 ± 100 BP) – that the appearance of the Ahrensburgian in the southern parts of Benelux may have started early in the Dryas 3 Stadial. Continuing the line of thought expressed above, this might suggest that Ahrensburgian immigrants quickly explored the void left by the supposed southern migration of the *Federmesser* groups. This would contradict the hypothesis[143] that there was an important hiatus after the Allerød/*Federmesser* occupation along these latitudes.

Several authors agree that the Ahrensburgian hunters came from the North, where they had pos-

126 Bard *et al.* 1987; Street *et al.* 1994.
127 Bosinski 1983; Bolus 1992.
128 Newell & Constandse-Westermann 1985.
129 Straus 1985.
130 Straus 1985, 114-115.
131 Arts 1984.
132 *e.g.* Van Noten 1978.
133 Van Noten 1978.
134 Fagnart 1993.
135 Bodu 1995.
136 Arts 1988.
137 Dewez *et al.* 1974.
138 Dijkstra *et al.* 1992.
139 Gob 1988.
140 Arts 1988, 310; Baales 1996.
141 Fischer & Tauber 1986.
142 Lanting & Van Der Plicht 1996.
143 By Street *et al.* 1994, 23.

sibly developed from the Bromme group, an early appearance of the Tanged Point Technocomplex[144]. Taking into account the large time gap, a direct development from the Hamburgian to the Ahrensburgian now seems unlikely. In our view, the hypothesis that *Federmesser* occupation in the southern sandy area directly evolved into the Ahrensburgian[145], is also unlikely. Recent analyses of technical attributes has shown that Ahrensburgian debitage can be distinguished from *Federmesser* debitage in this region[146].

The lithic assemblages from Geldrop I and Molenheide 2, Zonhoven are comparable in terms of tool types, tool frequencies (except perhaps for the number of scrapers) and waste products (similar blade and core morphologies[147]). If their dates can be confirmed in future, then this would imply that, in Benelux, obliquely truncated points (Zonhoven points or B-points in the Dutch terminology) can outnumber Ahrensburgian points in assemblages early in the Dryas 3 Stadial. The origin of these obliquely truncated points is still subject to debate. Together, the Ahrensburgian assemblages display a variety of point types, commonly marking a further microlithisation. Common tools such as end-scrapers, burins and borers become less important.

Nothing is presently known about the subsistence strategies at the Ahrensburgian open air sites. In the caves, the fauna were dominated by reindeer, although a range of other animals was also present. The reindeer bones reveal numerous traces of butchering. The season of occupation in those sites was spring. Based on an exhaustive study of the Ahrensburgian evidence in the northern part of the NW European Upland Zone ('*Mittelgebirge*'), Baales[148] recently concluded that the Ahrensburgian economy was essentially based on the seasonal hunting of migrating reindeer herds. After spending the winter in the adjacent cold, but relatively snow free lowlands, man would have followed the reindeer as they moved to the Upland Zone during the spring months to give birth to the calves on the summer feeding grounds. At suitable locations, man would have lain in waiting for the herds and would have hunted them by the 'head-'em-off-at-the-pass' method.

1.2.2.6 *Early Mesolithic*

In the central region of Benelux some small sites (ø 4-5 m) such as Sonisse Heide a and x, Helchteren[149]; Terlamen 1-3, Zolder[150]; De Waag, Achel[151] and Luienberg, Assent[152] have yielded assemblages with a few larger blades and poor tool inventories including scrapers, burins, and truncated elements, along with backed pieces, segments (Azilian points?), rare microliths and microburins. Sadly, these sites have yet to be dated properly and their homogeneity is not fully established. However, a (restricted) presence of Wommersom quartzite and of the microburin technology is in our view incompatible with the typical *Federmesser* sites of the Allerød. Awaiting better information, we consider them to be a prelude to the Mesolithic, with (as opposed to the Ahrensburgian) possibly a southern affinity. In the Netherlands, the recently excavated site at Posterholt, Ambt Montfort[153] might also be regarded in this context. A date at the Dryas 3/Preboreal transition would comply with our expectation.

So far, no sites with bruised blades (*lames machurées*) are recognised in Benelux. In neighbouring British and northern French sites such assemblages are also dated at the Dryas 3/Preboreal boundary[154].

All in all, we agree with others[155] that current evidence for late Glacial occupation suggests that, compared with the Allerød settlement, the population density decreased in Dryas 3.

Current evidence does not suggest a rapid increase in population density at the onset of the Holocene. The present radiocarbon record (fig. 2) includes 14 sites with dates in the tenth millennium BP. Three of these were expected to be linked with Creswellian and *Federmesser* assemblages (Trou Walou, Trooz; De Banen, Nederweert and Rekem 10). Most others lie in the second half of the Preboreal. After the calibration of the 'reliable' dates, the 10th millennium cal BC remains completely empty (fig. 3).

Various attempts at the geo-chronological classification of the Mesolithic in Benelux have been hampered by the poor resolution of the absolute chronology[156]. Some dating work in progress[157], using exclusively charred hazelnuts, may eventually shed some new light on this problem. Despite their anthropological interest, the well-dated Mesolithic burials (notably Grottes des Sarrasins, Loverval; Petit Ri, Malonne; Margaux and Autours Caves in Anseremme-Dinant) are unlikely to contribute much to the archaeology/chronology debate since very little is known about their related material culture[158].

In typological terms, the early Mesolithic is characterised by numerous obliquely truncated points, laterally retouched points, the generalised introduction of triangles, and the widespread presence of microburins. Segments are important in some sites, for example in the Ardennes. Wommersom quartzite is clearly now being used, but mainly at sites fairly close to its outcrop near Tienen, in Central Belgium[159].

Several authors have stressed the close resemblance of some Early Mesolithic inventories with the Ahrensburgian. According to Gob[160], the main characteristics of the so-called Epi-Ahrensburgian are the inclusion of common tools of classical Ahrensburgian type, with a trend towards smaller pieces and a reduction in the amount of burins, a scarcity or lack of true tanged points, a predominance of Zonhoven points and the presence of atypical geometric microliths derived from tanged points (triangles; small, and irregular trapezes). From a technological point of view, some Early Mesolithic assemblages show more affinity with *Federmesser* knapping techniques[161]. It may also be noteworthy that site locations of the Early Mesolithic are often very close to former *Federmesser* settlements. With regard to subsistence, the evidence is again very poor since the open air sites have hardly produced any bone material.

144 Taute 1968; Fischer 1991.
145 Rozoy 1978.
146 De Bie 1999.
147 Compare Deeben 1994 with Peleman *et al.* 1994.
148 Baales 1996.
149 Vermeersch 1974.
150 Vermeersch & Carolus 1975.
151 Vermeersch 1979.
152 De Bie *et al.* 1992.
153 Verhart 1995.
154 Barton 1989; Fagnart 1993.
155 Arts 1989; Street *et al.* 1994.
156 Newell 1973; Rozoy 1978; Gob 1981; Vermeersch 1984.
157 Crombé & Van Strydonck 1994.
158 Jadin & Carpentier 1994; Cauwe 1995; but see Otte *et al.* 1994; Straus *et al.*, 1999, concerning the adjacent, slightly younger campsite of Abri du Pape.
159 Gendel 1984.
160 Gob 1991, 229.
161 De Bie 1999.

1.3 Changing approaches in site analysis

1.3.1 Introduction

It may be concluded from the previous sections that research on sites of the *Federmessergruppen* has for some time exclusively focused on typo-chronological issues.

Meanwhile, other intra-site research avenues had been proposed and methods developed for a different approach. In the Anglo-American tradition, these were primarily stimulated by the 'New Archaeology', introducing concepts like 'tool kit' and 'activity area'[162], concern about formation processes[163], and special attention was also paid to these issues in ethnoarchaeological work[164]. Increasingly sophisticated methods were developed in order to detect and describe 'significant patterns' in the spatial record, and it was hoped that the (re-)discovery of microwear analysis[165] would sustain the theoretical concepts. In more recent years it was realised that many of the early assumptions and ideas of spatial analysis were quite naïve and site formation processes appeared to be far more complex than had initially been believed.

On the European continent, on the other hand, a long tradition of site reconstruction[166], based on the visual inspection of artefact distributions, stimulated large-scale horizontal excavations and the detailed recording of artefacts. Exemplary amongst the new type of empirical intra-site analyses were the investigations on the Magdalenian open air sites of the Paris Basin where A. Leroi-Gourhan and M. Brézillon combined refitting and spatial studies for their seminal 'ethnographic analysis' of a Magdalenian habitation at Pincevent[167]. The methodology was quickly followed at other sites in the Paris Basin (*e.g.* Etiolles, Marsangy, Verberie) and abroad (*e.g.* Gönnersdorf) and led to spectacular results in the last decade. These results provided insights into the social structure and dynamic evolution of Magdalenian camp sites[168].

After the addition of microwear research to the refitting and spatial analyses[169], this combined approach has frequently been advocated as an extremely productive research strategy. The investigations at Meer were often cited as exemplary in this respect[170]. It should be noted, however, that, in spite of the claim of introducing dynamics in site analysis, research at Meer II was not explicitly concerned with the progressing of systemic formation processes (section 1.3). The site was essentially conceived as a camp where all activities occurred more or less simultaneously in distinguished locations. Microwear analysis was restricted to a preliminary study, and instead of attempting the exhaustive reconstruction of the site's occupation history, the authors instead presented examples of refitted co-sets – obviously the most spectacular ones – which they seemingly assumed to be representative of the whole site. Moreover, as stated above, a possible Mesolithic admixture and the partial destruction of Meer II probably did not make this the most appropriate site on which to demonstrate the 'palaeo-ethnographic approach'[171].

Sites where this strategy has been conducted to its full potential, are still extremely rare[172]. A major reason – besides problems of preservation – is presumably the labour-intensity, and thus high cost, of each of the methods combined in this approach. Both refitting and microwear analysis are time-consuming techniques and although GIS and desktop mapping programs have considerably alleviated the plotting of artefacts, the number of variables potentially significant for spatial analysis is almost infinite. The interpretation of distribution plans therefore remains an arduous endeavour.

A major challenge of the present contribution will be to convince the reader that the ambitious goals declared in section 1.5 can indeed be set and reached with an appropriate research strategy based on the approach outlined above and described in section 1.4.

1.3.2 Regarding the genesis of a Palaeolithic site

Before plunging into the proper intra-site analysis, some considerations about the genesis of Palaeolithic sites may be useful. Obviously, an understanding of how hunter-gatherer sites are initially formed and subsequently affected is crucial if one seeks to make inferences about past human behaviour.

When analysing artefact distribution plans at Palaeolithic sites, a few things should be constantly borne in mind. A major assumption underlying all interpretation is that the distribution of the archaeological material mirrors the patterning of daily life in a prehistoric settlement: one hopes to find 'fossilised human behaviour' in these plans. Important questions therefore need to be addressed. How did a Palaeolithic site emanate? What processes contributed to the formation of its ultimate layout as we perceive it today?

In this, two major categories/contexts of formation processes have been traditionally distinguished[173]:

162 Whallon 1973.
163 Schiffer 1972, 1976.
164 *e.g.* Yellen 1977.
165 Keeley 1980.
166 *e.g.* Rust 1958.
167 Leroi-Gourhan & Brézillon 1972.
168 *e.g.* Pigeot 1987; Bodu 1993; Leesch 1997.
169 Keeley in Van Noten 1978.
170 *e.g.* Stapert 1989, 2; Blankholm 1991, 26; Renfrew & Bahn 1991, 280-281.
171 Clearly, the volume of Meer II remains an outstanding site report, and we will of course repeatedly compare our results with those obtained there 20 years ago.
172 The analysis of the Magdalenian site at Verberie (Audouze *et al.* 1981; Keeley 1991) is one example we know of, but the final publication is still awaited.
173 Schiffer 1987.

1) the systemic context, *i.e.* processes in action during prehistoric occupation, and
2) the archaeological context, *i.e.* all post-abandonment factors, both natural processes and human influence, either unconscious (building, ploughing) or during archaeological work.

Before depicting both contexts, it should be noted that the ultimate spatial layout is equally codetermined by the physical state (topography, vegetation, location of trees) and the geomorphology of the location before human arrival.

1.3.2.1 Depositional processes (systemic context)

With regard to temporary, relatively short-lived camps of migratory hunter-gatherers, such as was most likely the case at Rekem, the working hypothesis that the discard location of artefacts is still reasonably related to use location (in the broad sense) may be adopted. The material record of activities, performed during the initial stages of occupation, is not necessarily blurred by elaborate maintenance activities. Nor is it completely drowning in immense palimpsests, as is normally the case on more continuously occupied settlements. In theory, one may therefore hope to gain a picture of activities performed throughout the complete settlement cycle. Still, it should be realised that even small, short-term sites are formed diachronically. Progressive, overlapping stages may be distinguished in this development[174].

1. *The settling-in stage*
During the initial phase of arrival, a site is largely designed by the construction (or possible refurbishment) of hearth(s), dwelling(s), etc., *i.e.* the fixing of more or less stable points and the general division of a camp layout into activity areas, rest places, transition zones, etc. The location of these points may be partly determined by the social structure of the arriving group[175]. This initial phase lays the foundation for the general occupation pattern. Regarding tools, the focus is generally on equipment for food procurement, rather than on processing activities.

2. *Exploitation stage*
During this main stage, a wide range of operations is being performed on a hunter-gatherer settlement, generally with a shift in emphasis on processing (food, clothing, etc.) and maintenance activities. Built structures become structuring elements in daily activities, guiding the dispersal of the more mobile elements. In turn, these constructions are now actively involved in the structuring of the social organisation (around hearths, inside the dwellings, etc.). The small-scale dispersal of artefacts is partly directed by the nature of the activities being carried out, and the number of individuals involved (*e.g.* working of large hides excites co-operation and demands considerable space; hafting of projectile points may be executed individually in a limited area but requires a hearth, etc.). Ultimately it is determined by discard procedures which are affected by processes such as hafting and retooling, tossing, dumping, cleaning up, etc. Trampling and scuffage, children's play, the presence of pet animals (dogs) and many other factors may further contribute to the systemic artefact dispersal. Finally, social relations (based on age, gender, kinship, etc.) and ritual prescriptions (*e.g.* taboos, status of hunter, etc.) may continue to have influenced spatial structuring. Ethnographic observations suggest that, although it is the most protracted stage and the one producing the largest amount of debris in absolute terms, on the whole, this phase tends to be quite stable in terms of space use. Because of its generation of abundant material, it is also most relevant for our understanding of intra-site spatial processes. However it would be erroneous to picture this as a discrete event as is often done in so-called palaeoethnographic reconstructions[176].

3. *Abandonment stage*
An increased intensity of activities normally characterises this phase which may have a considerable effect on the spatial record. Extinction of the hearths, and especially the dismantling of dwellings and built structures always have at least some impact on the general layout (*e.g.* displacement of stones used on tent-covers). Artefact production now normally focuses on tools deemed to be functional in future contexts. Dumping and cleaning up activities tend to abate. Former refuse disposal areas, or isolated workshops, therefore, may be less affected by this phase. Selection and withdrawal of (lithic) artefacts away from the site (blanks, tools, cores), depends heavily on the general techno-economical strategy (curated or expedient technology), destination and projected needs at future locations, capacity of transport, intentions of returning to the site, etc.

From this short overview, it may be inferred that the progressive systemic (trans)formation of hunter-gatherer sites makes archaeological remains, produced during different stages of occupation, subject to varying degrees or types of 'cultural formation processes'. Evidently, elements generated during the initial phases of occupation have more chance to be displaced in the course of later activities, both laterally and vertically. The latter movement may be incited by trampling (*i.e.* embedding of items, especially in permeable substrates) but can also be caused by intentional navying (cooking pits, stake holes, fire pits, etc.). The generation of 'swelling' palimpsests during longer-term occupation will also increasingly hamper accurate interpretation. Spatially isolated individual events should obviously be more easily identified. Conversely, the processes of refuse disposal may be more intense in larger habitation sites and might ultimately also generate recognisable patterns. Needless to say, all these elements should be taken into account when attempting to translate artefact distributions into terms of human behaviour. In addition, it should be remembered that this three-stage cycle

[174] Stevenson 1985, 1991; Cziesla 1990a.
[175] Gargett & Hayden 1991; Whitelaw 1991.
[176] *e.g.* Pl. 64 in Van Noten 1978.

of site formation may be repeated during any possible reuse or revisiting of the site. We will obviously return to these problems in our spatial analyses (chapter 6). However, because a thorough understanding of the techno-economical context at issue is, in our opinion, a prerequisite for a pertinent interpretation, an intensive program of artefact examination will precede this undertaking (chapter 3-5).

1.3.2.2 Post-depositional processes (archaeological context)

As an additional complicating factor, a whole range of post-depositional processes may act to modify the archaeological record. Some of these create displacement before the burial of the site in depositional environments. They include scavenging by carnivores[177] attracted by faunal remains and a range of geomorphological processes, some of which are superficial, while others may be erosive: wind action, rainsplash, water channelling, landslip, etc. The natural disturbance of the site further continues in the subsurface environment, especially when soil formation processes are involved[178]. They include bioturbation by earthworms and other burrowing animals, root growth and decay, cryoturbation, treefall, etc.

While it is unlikely that all these taphonomic processes have been active in the sand environment at Rekem, it is acknowledged that most are capable of moving artefacts, both vertically and horizontally. In the broadly contemporary sand site of Hengistbury Head, where an elaborate attempt has been made to calculate their impact, it has been suggested that subsurface processes would not have produced horizontal dispersal of greater magnitude than the observed vertical dispersal. The exceptions to this rule are probably rare and unpredictable cases involving large burrowing animals[179]. While this may be employed as a general indication of the magnitude of horizontal displacement, we do not believe that the natural effects can be quantified in such a way as to allow the site to be 'reconstructed' to a stage before the post-depositional processes had had time to take effect, as has been suggested for instance by Barton[180]. In the first place, the true long-term effect of many of these processes is still poorly understood and secondly, as the dispersal is a cumulative result of a number of different processes, partly acting simultaneously, the complexity of the matter can hardly be overestimated. It would probably be a mistake to expect that we can apply natural transforms like formulas and restore sites to their pristine glory[181]. On the other hand, it would be erroneous to simply ignore the potential effect of natural processes on the spatial record. We will therefore return to this issue in our discussion on the vertical dispersion of artefacts at Rekem and also attempt to assess the impact on the horizontal plane (chapter 6).

As a general conclusion, it should be retained from this section that a whole range of factors continually contributed to the formation and spatial layout of an archaeological site. These are all dynamic processes, while the archaeologist is essentially confronted with one single picture, which in the best of possible scenarios only reflects the state of the prehistoric settlement as it was, after the last inhabitant had left the camp area[182].

1.3.3 Some definitions of 'spatial units' as adopted in this book

We use the following definitions when we indicate spatial units at Rekem. Note that 'site' and 'locus' essentially refer to the archaeological context, while 'settlement', 'camp', and 'dwelling' are interpretations of the units in the systemic context.

Site: Area with remains of former human occupation, which are perceived as an archaeologically meaningful aggregate. At Rekem, 'site' refers to the excavated area containing *Federmesser* material.

Locus: Spatially isolated concentration of archaeological remains within a site (*i.e.* Rekem 1, Rekem 2, etc.).

Settlement: 'An archaeological settlement is the physical locale or cluster of locales where members of a community lived, ensured their subsistence, and pursued their social functions in a delineable time period. In space, then, an archaeological settlement need not lie in one continuous expense of ground [...]. If a repeatedly occupied site with a great depth of cultural debris can be demonstrated to have been the locus of a single community during one or several occupations in which no significant or meaningful changes in community configuration or structure took place, then we may consider the site to be that of a single archaeological settlement'[183].

Camp: Short-term settlement, generally in a context of hunter-gatherer societies.

Dwelling: any kind of hut, tent, windscreen, or other structure that has given protection on the settlement.

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177 In the Central Rhineland, the following carnivores have been recorded in an Alleröd environment: bear, wolf, fox, badger, marten (Baales & Street 1996; see also Charles 1997).
178 Wood & Johnson 1978.
179 Collcutt in Barton 1992, 68.
180 Barton 1992.
181 cf. Gamble 1991, 15.
182 Unless, of course, some kind of Palaeolithic Pompeï is discovered in the future, a possibility which cannot in fact be fully discounted for *Federmesser* sites in the Neuwied Basin.
183 Chang 1968, 3.

1.4 Research methods

1.4.1 Attribute analysis

Along with a general morphological and typological description of the blanks, cores, tools, and tool waste, various kinds of attributes of these artefact categories have been systematically recorded. These include metrical attributes (dimensions, weight) as well as a whole range of qualitative and technological features, some common for all artefact groups (raw material, condition), others specific for one category (*e.g.* blank type) or one type of tool (*e.g.* angle of burin bevel). All these observations are inventoried in the annexes and are summarised in numerous tables and graphs, which are discussed in the various chapters on debitage and tools, leading to an accurate characterisation of the flint assemblage.

1.4.2 Refitting

The lithic material at Rekem offered excellent refitting potential, permitting the study of both reduction strategies (for flint) and spatial distributions (for both flint and rocks). Refitting, *i.e.* putting core(s), flakes, tools, tool waste, and fragments from the same block of stone back together in the original sequence of production, has become a common research technique, of which the practicalities have often been explained[184]. The origin and history of this method also has been repeatedly reviewed[185].

The refitting program, started by R. Lauwers and continued by M. De Bie, with occasional help from volunteers, took several years, but was repeatedly interrupted by other work. Unfortunately, there has been no systematic recording of the time invested in this operation and we are not able to accurately recalculate the man hours involved. It is also obvious that more work can be done, but the state of the database presented here (as of March 1998) is presumably a good representation of all potential conjoinments on both flint and rocks.

The success of refitting is largely dependent on the characteristics and variability of the raw material (colour, internal varieties, texture, cortex types, etc.). Although some previous knowledge of flint knapping and of the specific reduction methods being reconstructed is advantageous, the eye of the refitter at work is primarily concentrating on purely material characteristics. Throughout our own refitting work, this emphasis has long been implicit. Only in the final stages of the project, especially in function of the spatial analysis, has the material been classified in detailed flint type units (section 4.2).

Refitting essentially contributed to two major research topics: lithic technology and spatial analysis. Both aspects are well-studied at Magdalenian open air sites in France (Pincevent, Etiolles, Marsangy, Verberie,), Germany (Gönnersdorf, Andernach) and Belgium (Kanne, Orp). Occasionally they have also received considerable attention in other Late Palaeolithic sites (*e.g.* Hengistbury Head, Oldeholtwolde). The results at Rekem will therefore regularly be compared with those obtained at these older sites when seeking aspects that seem to be specific to the *Federmessergruppen*. These will be further compared with evidence from other *Federmesser* sites (especially Meer, Niederbieber, Andernach, Saleux, Rueil-Malmaison, and Rydno).

With regard to lithic technology, and in addition to the attribute analysis, the refitting provided better insights into both flint knapping methods and into the processes of tool manufacture and maintenance ('tool use lives', chapter 5). On a spatial scale the results could be used to measure the degree of vertical dispersal and to assess the disturbance on the site by natural post-depositional processes. Most importantly, however, the mapping of refits supplied important insights into horizontal patterning both in and between the various loci (chapter 6), as it shows the relationship between the manufacturing process and artefact discard, and as it elucidates the transport patterns of both flint artefacts and rock fragments.

Note on the mapping of refits

Since there are many possible ways to outline the spatial connection between refitted artefacts[186], some explanation of the system applied in this work may be useful. Although this may seem a rather technical question, the type of visualisation can have a considerable effect on the (first) impression a reader gets from the maps. A simple example can be used to illustrate this. Fig. 6 shows a refitted co-set (16c01) as we choose to map it (example A) and the same refit portrayed in a different way (example B), in this case connecting every contacting surface (one type of line)[187]. The latter representation seems to reveal a rather intense traffic between Rekem 16 and Rekem 12 and between Rekem 12 and Rekem 15. It is more likely, however, that there had been a single transport from the core, first exploited at Rekem 16 and then further reduced at Rekem 12. From both concentrations a single artefact then moved to Rekem 15. Such considerations are of course important for the assessment of the (chronological) relationship between different loci[188].

In this work, three major kinds of refits are distinguished[189]: production sequences (debitage), modification sequences (resharpenings), and breaks (fig. 7). For debitage production sequences (solid lines) and tool modifications (dashed lines), arrows indicate the technological direction of the sequence from the outside to the inside, that is from the first flake removed to the abandoned core or from the first (re)sharpening flake (*e.g.* burin spalls) to the final tool. Connections between broken pieces are shown with an interrupted line (dash-dot), without any indication of the directions involved.

184 See *e.g.* Cahen *et al.* 1980; Cziesla *et al.* 1990.

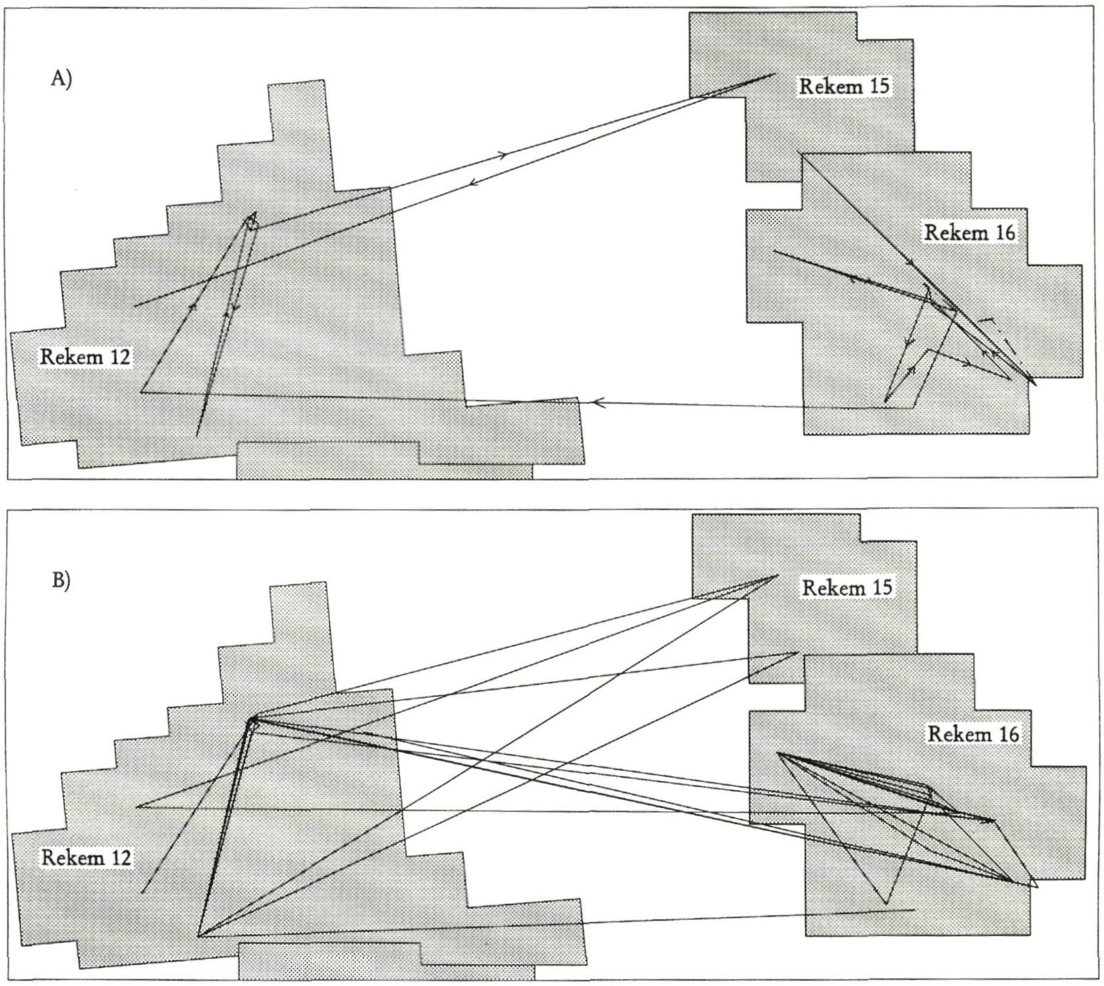
185 *e.g.* Cziesla 1990b.

186 For several examples, see Cziesla 1990b, 23.

187 This method is for instance suggested by Cahen 1976.

188 A full discussion of the interpretative possibilities of co-set 16c01 is given with the detailed description in section 4.4.2.11.

189 Following Cziesla 1986, 1990a, 1990b.

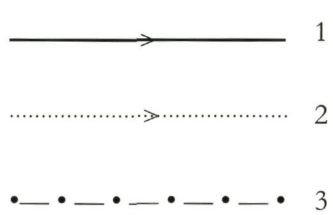


6 *Several possibilities of spatial representation of refits:*
A) indicating sequence of reduction;
B) connecting every physical contact between artefacts.
Example: refitted co-set 16c01.

On earlier versions of the maps, we also added symbols to represent whether the connection was direct (*e.g.* two blanks produced immediately one after the other, two fragments effectively connected, the last burin spall with its burin, etc.) or whether intermediate elements were missing. We also indicated technological changes within the process, thus splitting the sequence into subsequences, corresponding with the major technological steps of the reduction process. It was hoped that these steps would also coincide with spatial moves. It soon became apparent, however, that in the (*Federmesser*) context at Rekem there was no indication at all for such correspondences and it was therefore decided to remove these additional graphics on the final maps provided in the present volumes, in order to keep the maps legible. In other contexts, however, such additional information might of course be useful.

Finally, we also partly modified Cziesla's suggestions for visual presentation of broken pieces on the maps, particularly in the cases where they are conjoined with other refit types. On our maps, only the (most) proximal fragments of the broken artefacts are integrated in the production sequence line or in the modification line. Other (medial or distal) fragments are connected with a break line type only (fig. 8). While this type of presentation does not obscure any information (to the contrary: it reveals the position of the proximal fragment) it helps to alleviate the complicated graphic representations. It also implies that the number of visualised connection lines on the maps agrees with the number of refitted artefacts, minus one: two refitted artefacts produce one line, three artefacts produce two lines, etc.

In conclusion, it may be useful to think about a production sequence line on the maps as a trajectory that was followed by the core while being reduced and leaving detached blanks behind, till the core itself was eventually abandoned. A similar im-



7 *Graphic presentation of refit-types for spatial analysis (after Cziesla 1990b):*
1. *Debitage sequence (Aufeinanderpassung),*
2. *Modification sequence (Anpassung),*
3. *Break (Aneinanderpassung).*

age can be used for a trajectory of subsequent tool modifications. Illustrating this in such a way agrees well with the general goal of our study, that is to reconstruct the sequence of events that occurred at this site. Remember that we only have the last image, a 'frozen picture', after all the protagonists are gone and, with them, part of the setting. We start with this final picture, first rewind the movie by gluing pieces back together, and then switch to 'play'.

Of course, this is a highly simplified image and should in fact only serve as a theoretical expedient. Blanks do not generally fall exactly on the spot where they were detached; modified and used pieces were transported at least once more and, as explained above, many other systemic processes and post-depositional disturbances may have altered the picture substantially. In fact, the goal of spatial analysis is to exactly reconstruct these processes.

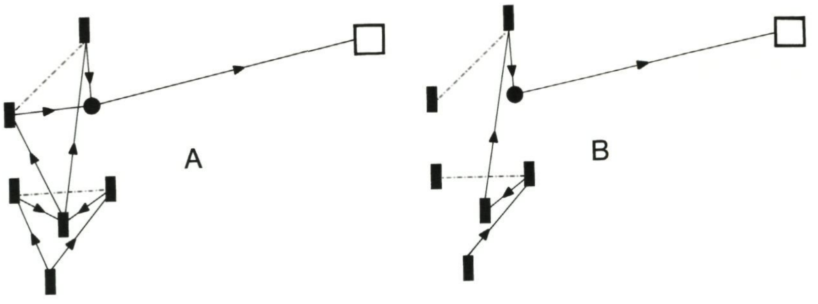
After having spent (lost) a substantial amount of time in mapping much of this information manually during the first part of the research project (creating action-painting-like graphs), access to an electronic total station and accompanying software (SDR33 by Sokkia™) in 1992 has alleviated the task considerably[190]. Other, specific programs, have been written and commercialised since[191], but except for a possible 3D display with Sitefit, we couldn't find many advantages in those. We rather preferred to integrate the refitting results into a general desktop mapping program (MapInfo™ Professional)[192], where we could combine refit maps with other types of information in different layers. Most of the maps produced here result from that procedure.

1.4.3 Microwear analysis

In considering the general research aims of the Rekem project, a comprehensive program of microwear analysis has been designed, and conducted by J.P. Caspar[193]. So far, all tools, tool waste products, edge-damaged pieces and all refitting blanks have been covered. An analysis of a large sample of non-refitted blanks has also been initiated, but the preliminary results of that part of the analyses have not yet been included in the present contribution. In all, for this work, 2635 pieces were studied under the microscope.

As with the refitting, the history and method of microwear studies have often been described. At Rekem, the high-power technique was employed, using an Olympus BHM microscope (ocular WHK 10X/20L, objectives MS Plan 5X, MD Plan 10X and LWD Plan 20X and 50X) with an incident lighting attachment, following standard procedures[194]. In short, the aim of this type of analysis is to identify past tool uses, with particular emphasis on contact materials and motions, by comparing use-wear traces, *i.e.* micro-polishes and striations, on surfaces and edges of archaeological implements with those obtained by experiments. In addition to the microwear analysis, particular attention has been paid to a systematic recording of diagnostic macroscopic features (fracture types, scars, macroscopic state of working ends).

8 *Various possibilities for presentations of break refits: A) integrating every fragment in the sequence; B) connecting proximal fragments only in the reduction line (modified after abb. 77 in Cziesla 1990a).*



The integrity of the analysis and interpretation of the archaeological material was tested with an extensive experimental program. Experiments with replicated artefacts of local raw-material sources – utilised in various ways on roe hide, pine wood, meat, bone, antler, and soft non-woody plants – provided controls. Moreover, an archery experiment was conducted in 1991 at the *Laboratorium voor Prehistorie* of the K.U.Leuven. The results of this particular experiment are discussed with the functional analysis of lateral modified points and bladelets (section 5.2.3.1).

The Rekem lithic material is well preserved at most loci[195] (Table 1). Moreover, use-wear traces could still be recognised on many microscopically-altered pieces. The observed use-wear on the various tool-categories is perfectly comparable to experimental use-wear. The functional attributes were mainly provoked by hunting or by the processing of animal matter (meat, hide, bone/antler). Far fewer traces of the working of vegetal (wood) or mineral matters have been observed. A large sample of the range of micro- and macroscopic traces on the Rekem lithics is illustrated on Pl. 108-115. The results of the functional analysis are essentially presented in chapter 5 and further intensively employed in the spatial analyses (chapter 6).

Finally, it should be stressed that, although there has been a close collaboration between the authors, microwear analysis was performed 'blindly', i.e. with-

190 We thank Prof. Philip Van Peer for his valuable help during the initial working sessions with the program.

191 *e.g.* Sitefit by Lindensoft® and Analithic by Akili Software.

192 Prof. Gerard Govers is to be thanked for drawing our attention to GIS potential in general and for advice during our first contact with MapInfo™.

193 This included a revision of all pieces formerly studied as part of master theses (Van Dooren-Van Overmeire 1985; Collin 1986; Ronsmans 1987; Missotten 1991).

194 Keeley 1980; Anderson-Gerfaud 1981; Moss 1983; Vaughan 1985a; Plisson 1985; Caspar 1988.

195 A possible explanation for the higher degree of mechanical alteration at Rekem 10 is discussed at the end of section 6.2.6.3.

Table 1
Rekem 1984-86. Microscopic condition of all tools, tool waste, edge-damaged pieces, and refitted blanks subjected to microwear analysis at the various loci.
* burnt pieces not considered

	Locus														
Condition for microwear	1	2	4	5	6	7	8	10	11	12	13	14	15	16	Total	%
Non-altered	280	14	28	692	273	123	2	107	139	209	28	27	23	131	2076	79%
Weak mechanical alteration	6	-	2	21	19	-	-	60	2	8	1	1	-	3	123	5%
Medium mechanical alteration	6	1	3	28	39	3	-	79	5	4	-	2	1	2	173	7%
Strong mechanical alteration	1	-	-	35	24	5	6	40	-	5	1	-	-	2	119	5%
Patined	-	-	-	1	1	-	-	-	-	-	-	-	-	-	2	0%
Burnt	26	2	-	35	28	14	-	13	11	7	1	2	-	3	142	5%
Total	319	17	33	812	384	145	8	299	157	233	31	32	24	141	2635	100%
% altered*	4%	7%	15%	11%	23%	6%	75%	63%	5%	8%	7%	10%	4%	5%	17%	
% burnt	8%	12%	0%	4%	7%	10%	0%	4%	7%	3%	3%	6%	0%	2%	5%	

out any previous knowledge of the refitting results, or of the spatial distribution of the artefacts. Refitted tools were detached before analysis, and there was no informing on the spatial layout of the site before microwear results had been obtained. On the other hand, the consistency with the spatial evidence (chapter 6) and with the refitting results (chapter 4), strongly supports the validity of the functional interpretations.

1.4.4 Spatial analysis

The study of the intra-site spatial patterning of lithic material at Palaeolithic settlements has been approached with resistance and scepticism ever since such a methodology was recognised and explored as a potential source of information about the human past. In the first place, site formation processes appeared to be of a more complex nature than initially thought (section 1.3.2). Archaeologists and ethnoarchaeologists became increasingly aware of the enigmatic relationship between 'use' and 'discard location' of artefacts[196]. Primary concepts and basic assumptions about 'tool kits' or 'activity areas', advanced as part of the New Archaeology, proved naïve and problematic even although methods have now been developed in an attempt to provide functional information regarding artefacts and tools. It was recognised that systemic processes, affecting the ultimate deposition of used items, are manifold (hafting and retooling, tossing, trampling, cleanup, dumping, children's play, etc.). Such 'secondary cultural formation processes'[197] are now considered principal determinants of the structure of archaeological refuse. Instead of being a filter of spatial patterns, it is generally acknowledged that they are an integrative part of the behavioural processes responsible for the observed distributions[198]. Still, since the effect of these processes is cumulative, they are capable of seriously complicating the interpretation of the spatial layout of the archaeological record. Finally, ethnoarchaeological studies have also found that if archaeologists want to adequately investigate the behavioural basis for spatial variation, they should start working on a significantly enlarged scale[199].

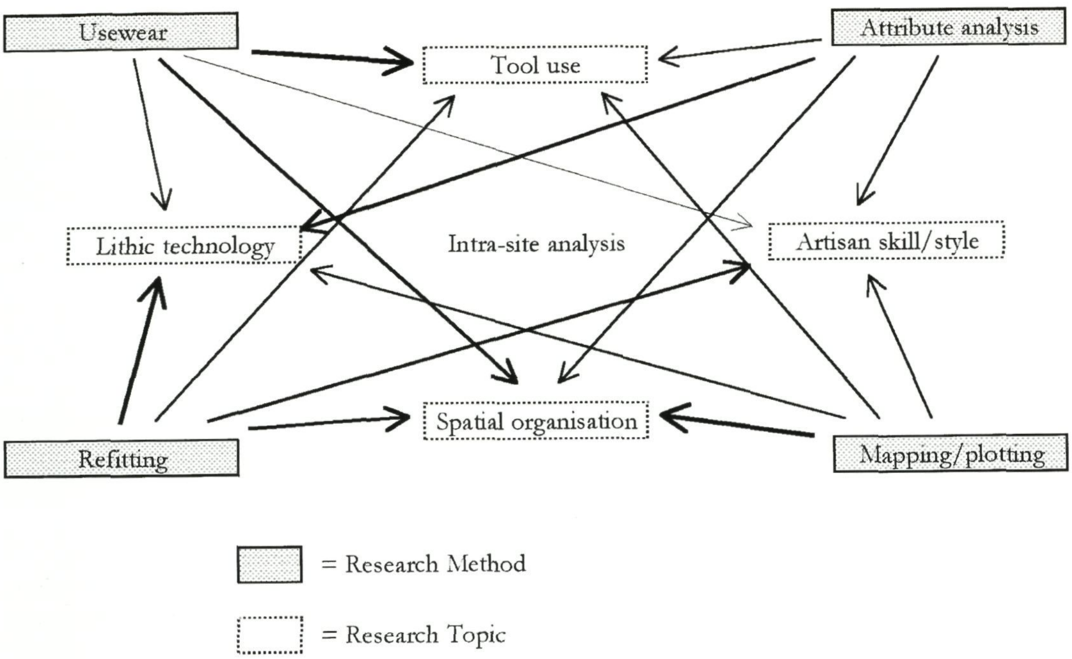
In addition, various contributions during the last few decades have stressed the impact of many natural disturbance processes on the spatial record[200]. Vertical migration, particularly on sites occurring on sands, has often been invoked as an indication of important post-depositional displacement[201], capable of considerably blurring the 'original' image.

Because of its exceptional state of spatial preservation (*i.e.* hardly disturbed by posterior human activities), and its great extent, Rekem was, from the beginning, deemed to be an appropriate test case for all such problems. Research was primarily designed as an attempt to evaluate the value and potential of spatial analysis on lithic scatters in sand sites. In this approach, use-wear analysis and refitting are fully employed as supportive methods. It is precisely with this goal in mind that both methods were pursued as far as reasonably possible.

So far, spatial analysis at Rekem has been conducted primarily with the 'visual approach', in its later stages facilitated by mapping software (SDR33 by Sokkia™, and Mapinfo™ professional) to enable the generation of thematic plans and transformed cartographic reproductions. Occasionally, some supportive graphs have been produced (essentially calculations of distance and orientation) but there has been no systematic use of so-called 'complex' statistical procedures that were introduced in the archaeological literature[202] during the last few decades. Although they may have some heuristic value, and can certainly be used for testing hypotheses[203], we have the overall impression that many of these procedures are no match for the complex processes involved in artefact distribution and they generally fail to contribute to the ultimate interpretation of the layout.

196 Keeley 1991.
197 Tani 1995.
198 Gamble 1991.
199 O'Connel 1987.
200 Wood and Johnson 1978; Schiffer 1987.
201 Vermeersch 1999.
202 Carr 1984; Kintigh 1990; Blankholm 1991.
203 A few loci were successfully studied with K-means analysis, as part of a masters thesis (Schurmans 1998).

9 *Model of integrated research strategy for intra-site analysis, as adopted at Rekem. Heavier arrows reflect more important contribution.*
Input: record of lithic material.
Output: insight into sequence of human activities in Late Palaeolithic camp.



Although there are occasional references to ethnoarchaeological evidence, as well as to experimental knapping, there has been no systematic screening of the literature for such parallels. This, in fact, would probably be a fertile itinerary for future work.

Because of the vast amount of information that is potentially significant for spatial analysis, our overall feeling is that this aspect of the research program is certainly not yet fully exploited. In fact, we are convinced that the site will remain a source of inspiration for many years to come. In chapter 6, we present a discussion of some of the remarkable results obtained so far and we focus on the detailed activity ranges and variations in the use of space within this *Federmesser* campsite. After an investigation of the vertical distribution, spatial variability is considered on two complementary scales:

1) comparison of contents, composition, and structure of the units of habitation zone 1 as a whole (*inter-locus*);

2) spatial patterns observed within the units (*intra-locus*). Our principal claim regarding point 2) is that post-depositional processes in Late Palaeolithic sand sites did not necessarily blur small-scale spatial patterns provoked by systematic human behaviour. In other words, we maintain that the distribution of artefacts still contains detailed spatial information on human activities, and that these can be positively identified against the background effect of post-depositional disturbance.

Finally, the reader may find it useful to know that three-dimensional co-ordinates of all cores, tools, tool waste products and refitting artefacts (i.e. a database of some 3500 items) are provided in the annexes 1-3. Anyone willing to use the data for further analysis can obtain the electronic version upon demand[204].

1.4.5 How to deal with this work ?

Since we have truly attempted to fully combine the methods described above in one integrated approach, there has been no clear-cut chronological order of investigation. As can be read from the diagram synthesising the research strategy at Rekem (fig. 9), every method and level of interpretation in our approach has constantly been affecting all other levels, thus constituting a network of intermingling part-studies, steadily inquiring of and stimulating each other. This was felt to be the most fruit-ful manner in which to proceed, as working on one aspect of the study often provoked research questions best dealt with from a different angle.

While this permanent shifting was not perceived as too complex for those directly involved in the exercise, it appeared to be much more difficult, if not impossible to accurately translate such a flexible and dynamic approach into a contents table and structure with separate chapters, all while trying to avoid frequent repetitions. In order to fully recognise the potential of this approach, the reader is therefore invited to shift and re-shift from one section to another when that need is perceived[205]. In the texts, we will also repeatedly refer to previous or subsequent sections, as well as to a whole range of figures, tables, plates, maps, and annexes.

1.5 Research goals of the Rekem project

Our (ambitious) goal with this work then, is to disentangle the following research topics:

a) Specifically for Rekem:

- Lithic technology: disclosure of raw material economy, knapping techniques (chapter 4), and tool manufacture processes (chapter 5), and establishing levels of knapping competence, design standards for tooling, stylistic variability, etc.
- Activity range: the reconstruction of activities conducted at the site, with special attention to tool/function relationships, hafting, tool biographies, patterns of tool discard etc. (chapter 5).
- Spatial patterning: the assessment of non-anthropogenic effects on artefact taphonomy (chapter 2), examination of the camp layout and depiction of the spatial organisation of the various activities (chapter 6) including its internal chronology (i.e. establishing the sequence of processes that successively led to the formation of the archaeological record and its possible disturbance).

This intra-site analysis should ultimately furnish a detailed picture of the scala of human handling in a *Federmesser* camp (daily activities) and, if feasible, shed light on social organisation and/or ritual behaviour in a Late Palaeolithic hunter-gatherer settlement.

b) In a wider perspective

- Establishing an integrated research strategy and exploring its potential for intra-site analysis on stone age sites.
- Assessing the value and limits of such an approach for sites situated in sand, affected by post-depositional disturbance, and lacking organic remains (chapter 6); providing suggestions for future excavation and site recording strategies in these contexts.
- Contributing to an improving perception of *Federmesser* settlement (dating problem, technology, settlement types), framed in the Late Palaeolithic of NW Europe.

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[204] Contact: Marc.DeBie@geo.kuleuven.ac.be
or Jean-Paul. Caspar@geo.kuleuven.ac.be.

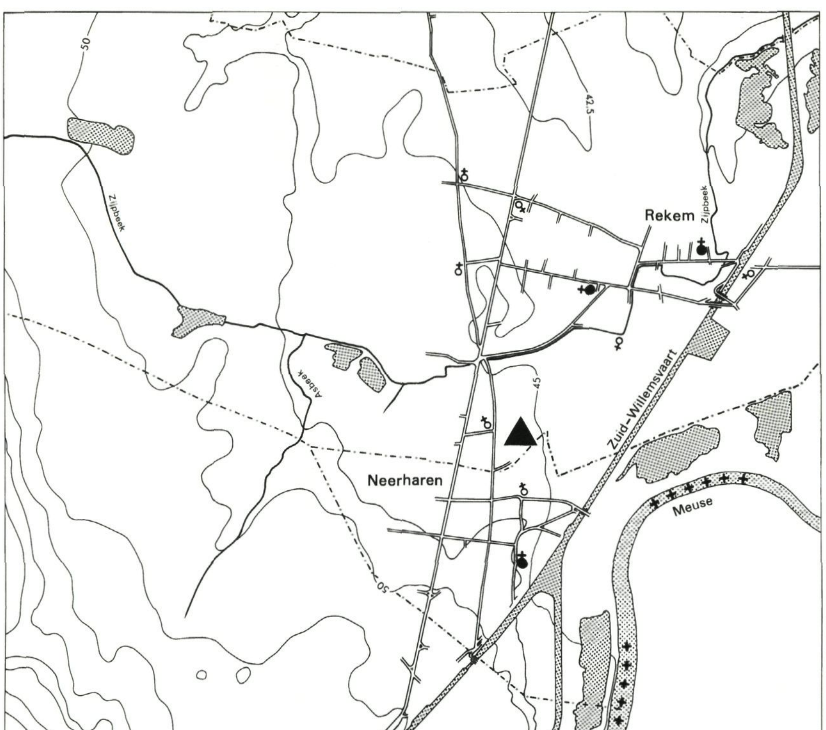
[205] For readers familiar with internet, this 'surfing' should not be too difficult. In fact, a website or CD-rom would probably be quite appropriate media for publishing this type of research results in the future.

2 Site Description and Environmental Setting

2.1 General layout and geomorphological setting

The site of Rekem (50°54'54"N, 5°41'24"E) is situated in the NE part of the Belgian lowlands, on the left bank of the Meuse, some 6km north of Maastricht, and at about 45m above the present sea level (fig. 10). The excavation trenches of the *Federmesser* site were located on the parcels with land register numbers 1201/g & h, 1202, 1203, 1204, 1205, 1206, 1209, and 1288 of the cadastral map Rekem (Lanaken), 3de afdeling, sectie B (fig. 11). The prehistoric remains were found on an elongated sandy elevation of Late Weichselian age, on the inner edge of a lower river terrace, about a kilometre from the present Meuse riverbed (fig. 12). The exact distance from the site to the Late Glacial river at the time of occupation is unknown, but an abandoned channel has been recorded only 150m from the site[1].

10 *Site location map.*



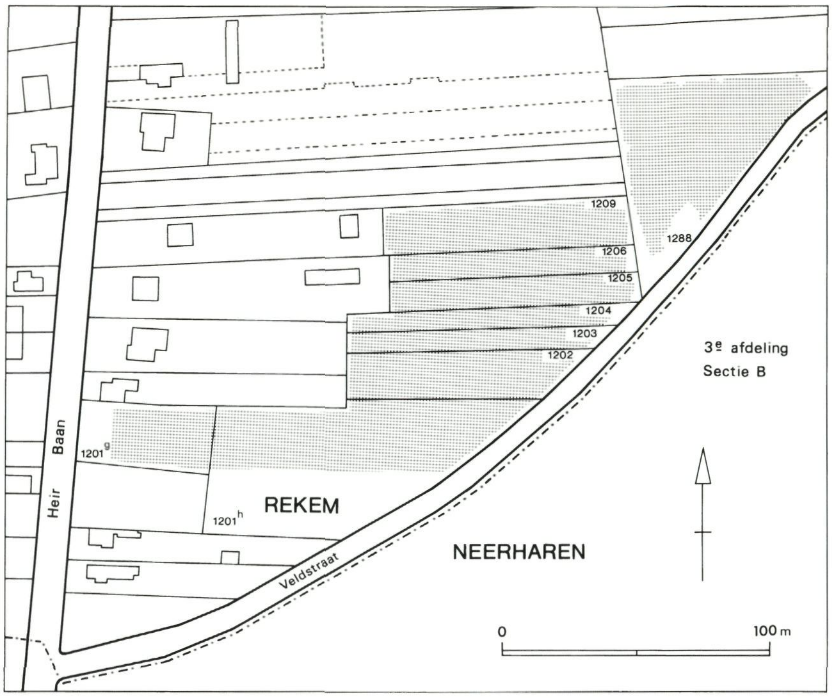
In all, 1.7ha were systematically excavated, with at least 16 spatially distinct units of lithic material identified and further referred to as 'loci'[2]. Little but lithic remains such as flint, quartzite, quartz, sandstone, and haematite were preserved. The sandy environment did not permit the preservation of organic remains, even in carbonised form, despite the ubiquitous evidence of fire-related rock features.

While the excavations have seemingly not yet exposed the entire settlement area, at least twelve concentrations of archaeological remains (Rekem 1, 4-8, 10-13, 15, and 16), called 'habitation zone 1'[3], and grouped in a NW-SE cluster, extend over a surface of about 80 X 35m (fig. 13). This distribution coincides well with the topography of the sandy elevation. At a distance of 80 to 110m E and W of this central area, were four other concentrations (Rekem 2, 3, 9, and 14), which possibly belong to neighbouring habitation areas.

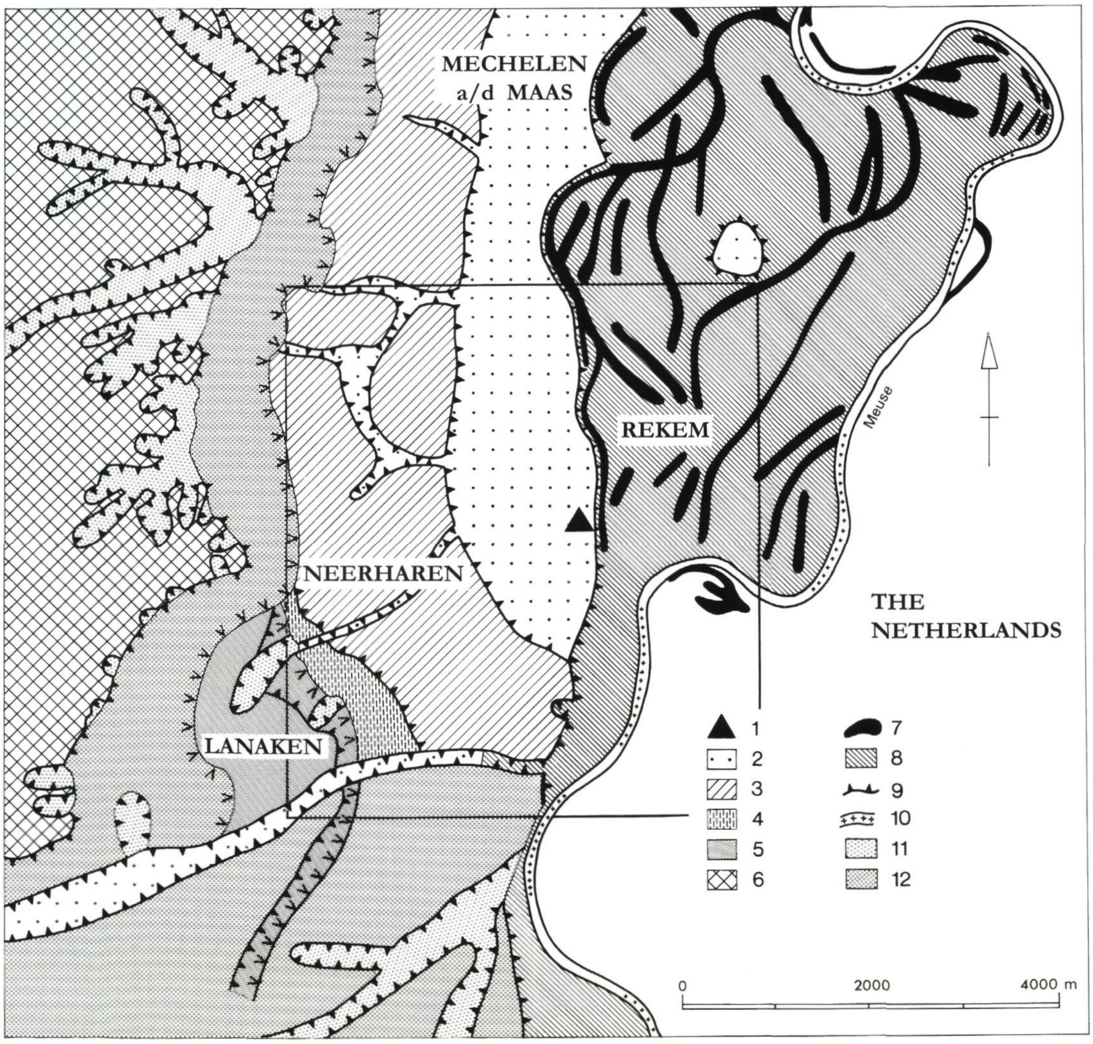
Within habitation zone 1, two neighbouring NW-SE alignments can be distinguished. The western line consists of large concentrations, each covering a surface of about 50 sq m (Rekem 10 and Rekem 12) to 60 sq m (Rekem 5 and Rekem 6) while smaller, nearly circular areas, rarely exceeding more than 4 to 5 sq m, form the eastern row. The large concentrations preserve evidence of decomposed structures, defined by numerous quartzite and sandstone pebbles most of which show traces of burning, and thus were probably hearth stones. At Rekem 10, traces of a semicircular structure (of ca. 5-6m diameter) could be perceived from the spatial distribution of the

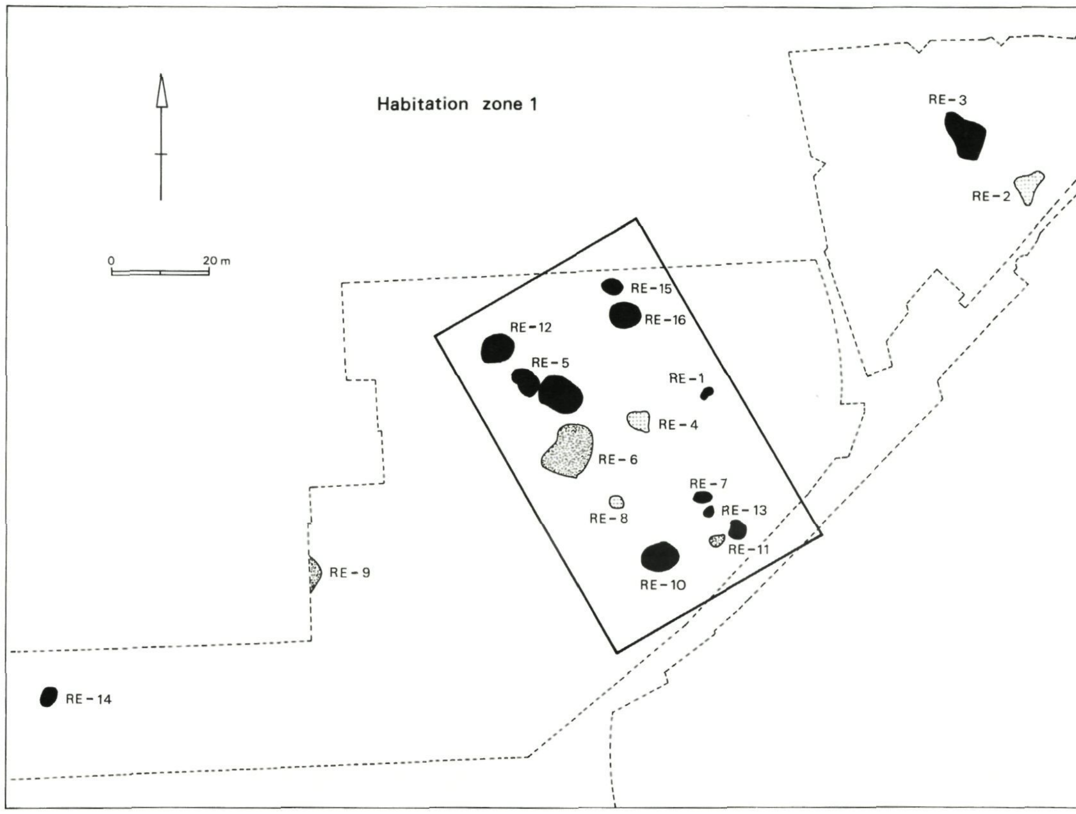
1 Paulissen 1973.
2 Provisionally we prefer this neutral term instead of "structures", "living floors", etc., because these designations are already loaded with interpretative connotations.
3 Lauwers 1988, 218.

11 *Cadastral map of Rekem with indication (dotted area) of the zone with Federmesser occupation investigated in 1984-1986.*



12 *Site location on a geomorphological map (after Paulissen 1973):*
1: Site location
2: Terrace of Mechelen a/d Maas (Würm)
3: Terrace of Eisden-Lanklaar (Riss)
4: Terrace of Caberg-Pietersem (Riss)
5: Terrace of Lanaken (Mindel-Riss)
6: Main terrace (Mindel)
7: Abandoned channels
8: Alluvial plain
9: Slopes and escarpments
10: Present riverbed of the Meuse
11: Valleys formed by periglacial or polygenetic processes
12: Coversand relief
The various terraces (2-6) are covered with Late Pleistocene coversands.
The frame indicates the limits of fig. 10.





13 *Rekem 1984-86. Map of the excavated area, with location of the 16 Federmesser loci. Twelve loci are grouped in habitation zone 1. Darker shadings reflect increasing artefact densities.*

dispersed lithic remains[4]. The varied inventories of these concentrations suggest a palimpsest of activities. The smaller areas produced a variable number of flint artefacts, and they represent the material record of a limited activity range, focused on flint working and tool production (Rekem 15, Rekem 16, Rekem 13, Rekem 7, and Rekem 11). They possibly also represent an additional function, that of refuse depository (Rekem 1), or limited other activities (Rekem 16 and Rekem 11). There is little material other than flint in these areas.

The topographical position of these loci, on an elevated sand ridge on the edge of the river bed, provided a view over the wide valley to the Northeast and a means to survey possible game animals attracted by the water. The river probably also supplied a rich fishing ground and in any case abundant lithic material. In all, it is not hard to imagine why the site was an appropriate location for camps of hunter-gatherers. In more recent history, this fertile strip of land between the alluvial plain and the Campine Plateau, remained the scene of an almost unbroken record of human activity[5].

2.2 Fieldwork

2.2.1 Excavation strategy

Given the exceptional state of preservation, and its threatened status, research at Rekem, from its inception, was aimed at the exhaustive recovery of the entire *Federmesser* settlement. The excavations were therefore designed to document the total extent of the occupation, while at the same time recording as much spatial detail as was reasonably possible.

2.2.2 Site recording

Large trenches, initially opened for the excavation of the (proto-)historic elements of the site and mechanically deepened to a level safely above the Late Palaeolithic horizon, were shovel-cleaned and the exact position of any artefacts encountered was measured. Over the three campaigns, 1.7 ha were investigated in this way. During this operation, the horizontal artefact dispersion appeared in clearly separated concentrations which allowed the consecutive numbering of the various loci in the field as they were being hit. Sixteen concentrations were thus discovered.

4 Lauwers 1988.
5 De Boe, De Bie & Van Impe 1992.

Once a concentration of artefacts appeared, a grid of 2m x 2m squares[6] was installed and each square of 4 sq m was labelled according to its smallest absolute co-ordinates : *e.g.* N2E14 = the square located from 2 to 4 m north of the site datum, and from 14 to 16 m east from that same point; S4W8 = from 4 to 6 m south and from 8 to 10 m west of datum; etc.. Artefacts found within these squares were numbered consecutively. The identification numbers written on the artefacts reflect this system (*e.g.* RE7/S6E32/122: 122nd artefact found in square S6E32 at Rekem 7). Whatever the position of the excavation square, the horizontal measuring of individual pieces (in cm) within these units always started from the SW corner: *e.g.* the position of artefact with field co-ordinates N145 E060 in square S6E8, is at -4.55m on the north-south (y-) axis, and at 8.60m. on the west-east (x-)axis.

The general origin (N0E0) of this grid system is situated at Rekem 6. However, throughout the various field seasons, some loci received a proper site datum. These 'local co-ordinates' were also used on the manually produced field plans (Map 2-24). Below (Table 2) is an overview of the location of these local data, as related to the general origin (situated in Rekem 6). With this correlation scheme, co-ordinates of different loci were transformed into a single uniform grid system, which is used on all the thematic maps that were generated electronically.

Once the grid was installed over a locus, excavation continued with trowels. At this point, slightly different site recording procedures were used in the consecutive years.

Method A (fig. 14): During the first season and for part of the second campaign, only non-flint rocks were drawn to scale on millimetre graph paper (scale 1/20). Flint artefacts were not immediately plotted in the field. Instead, their co-ordinates (North, East, and Level), were recorded on data sheets, where other information was also stored (orientation – horizontal, vertical, or oblique – of the flint pieces, stratigraphic layer, raw material, physical state, artefact type, excavator's name and date of find, other remarks). When encountered during the excavation, chips were also registered on these sheet. In addition, the sediment was dry-sieved using a 5 mm mesh screen. The chips recovered from the sieve were bagged collectively by 1 sq m. The plans of the flints and rocks from these loci are provided separately.

Method B (fig. 15): The recording technique was modified in the course of the second field season, starting with Rekem 11. All artefacts (flint and rocks) were then drawn to scale on field plans (scale 1/10). Their horizontal co-ordinates were no longer mentioned on the data sheets (all other features were maintained). Small flakes (chips) were also plotted on the field plans, but were no longer numbered. They were bagged collectively by square meter, together with the chips collected from the sieve. Finally, samples were also taken to screen the sand for micro-chips (flint-dust). Preliminary inspection showed that these are quite abundant in the dense (presumed) debitage areas, but the samples have not yet been subjected to further analysis. On the whole, the great advantage of this modified recording method is the immediate visibility of artefact size on the plans. Because chips were no longer numbered and inventoried on the data-sheet, the excavations also proceeded more rapidly.

The recording method used at the different loci, as well as the extent of the excavated surfaces is shown in Table 3.

Finally, it should be stressed that all artefacts were also given individual spot heights (in cm). All level measurements were related to the top of a concrete pillar on the road, of which the height was arbitrarily established at 10m.

Table 2
Co-ordinate system Rekem 1984-1986

Origin		Loci concerned
0N	0E	Rekem 1, Rekem 5, Rekem 6, Rekem 7, Rekem 8
-38N	-64.3E	Rekem 9, Rekem 10, Rekem 11, Rekem 13
-70N	-122.3E	Rekem 14 (former Rekem 15)
+22N	+15.7E	Rekem 15 (former Rekem 17), Rekem 16
0N	+60E	Rekem 4, but: first make E-co-ordinates negative (in fact subtract E-co-ordinates from 60E)
+12.80N	-21.58E	Rekem 12, but: also rotate -5.5° (using 400° and 0N0E as rotation point)
+0N	+60E	Rekem 2, but: thereafter, also rotate -52.2° (using 400° and -2N60E as rotation point)
+20N	+0E	Rekem 3, but: thereafter, also rotate -52.2° (using 400° and -2N60E as rotation point)

[6] At Rekem 1, initially 1m x 1m squares were used, but it soon appeared that these were in fact too small for a person to work in properly.

14 *General view on the excavations at Rekem 5 (1984). Note the numerous nails: flint artefacts were not drawn to scale, but plotted as points, based on coordinates recorded on datasheets.*

Table 3
Rekem 1984-86. Excavated surface and registration method at the various loci.(Italic characters are loci outside habitation zone 1)

Locus	Excavated surface (sq m)	Registration method
Rekem 1	71	Method A
Rekem 2	*116*	*Method A*
Rekem 3	*tested*	*No trowelling*
Rekem 4	90	Method A (but only 1 map)
Rekem 5	148	Method A
Rekem 6	187	Method A
Rekem 7	56	Method B
Rekem 8	ca. 21	Very few artefacts
Rekem 9	*93*	*Method A (partial excavation)*
Rekem 10	138	Method A
Rekem 11	103	Method B
Rekem 12	137	Method B
Rekem 13	72	Method B
Rekem 14	*66*	*Method B*
Rekem 15	36	Method B
Rekem 16	97	Method B
Total trowelled	ca. 1431	
Total shovel-tested	ca. 17000	

15 *General view on the excavations at Rekem 11 (1985). All artefacts were drawn to scale on fieldmaps.*

2.3 Chronology and palaeoenvironment

2.3.1 Stratigraphy and pedology

2.3.1.1. Description of profiles

Eight stratigraphic profiles were studied at habitation zone 1 (fig. 20). Two of these were sampled for grain size analysis but the samples have not yet been sieved. Because of the general agreement of the stratigraphy between the various loci, only 3 profiles are described here based on field notes by P.M. Vermeersch and R. Lauwers. A photograph of a profile taken at Rekem 1, is shown on fig. 16.

Profile 1: Rekem 16 (fig. 17)
N7.5E10-2; North face

Level 0 (9.95m-9.30m): dump of 1982 campaign
Level 1 (9.30m-9.15m):
- light brown mottled sand with iron fibres and manganese compaction
- numerous animal burrows filled with recent material
- transition to level 2 is diffuse

Level 2 (9.15m-8.80m):
- bleached sand, light yellow above water table, yellow brown beneath water table
- increasingly homogeneous sand
- diffuse upper and lower boundary

Level 3 (8.80m-8.60m)
- grey-brown sand (mottled)
- transition to level 4 is irregular

Level 4 (8.60m-8.40m)
- slightly loamy sand, orange brown, with numerous manganese patches
- sporadic presence of small granules
- boundary at the base is sharp and continuous

Level 5 (8.45m-8.15m)
- distinctly layered coversands, on top slightly enriched with brownish humic material
- upper 10 cm comprises numerous manganese speckles
- lamination is accentuated by oxidation-reduction phenomena (clear colour variation)

Level 6 (below 8.15m)
- gravels = terrace of Mechelen-aan-de-Maas

Profile 3 : Rekem 6/5 (fig. 18)
N9E13; North face

Level 0 (9.90m-9.50m): arable layer
Level 1 (9.50m-9.25m):
- light brown mottled sand with iron and manganese concentrations
- numerous root traces, filled with material from arable layer
- animal burrows filled with material from arable layer, and from underlying yellow sands

- transition to level 2 is diffuse, but accentuated by iron streaks (infiltration of ferriferous material)

Level 2 (9.25m-9.00m):
- light yellow-brown
- transition zone between brown illuvation and white eluvated horizon, with irregular boundaries
- numerous animal burrows
- increasing homogenisation of sand, with diffuse humic patches
- presence of numerous living radicells, or radicells filled with organic material or manganese

Level 3 (9.00m-8.70m)
- bleached, slightly loamy sand with local brown colour (recent enrichment); on other locations is eluvated aspect better discernible; sporadic presence of humus
- sporadic presence of small (Meuse) granules that may be aeolian
- numerous fossil radicells
- iron accumulation (cf. above) is locally weakly solidified in small patches (∅ max. 3 cm), apparently related to underlying consolidations (gleyification)
- transition to level 4 is sharp but irregular

Level 4 (8.70m-8.45m)
- slightly loamy sand, orange brown, with numerous manganese patches
- no lamination, moderately compact sand
- no observation of radicells
- probably (sub)recent iron precipitation
- boundary at the base is sharp and continuous

Level 5 (8.45m-8.00m)
- distinctly layered coversands, upper levels slightly enriched with brownish humic material
- upper 10 cm comprises numerous manganese speckles
- lamination is accentuated by oxidation-reduction phenomena (clear colour variation)
- no cryoturbation
- iron precipitation

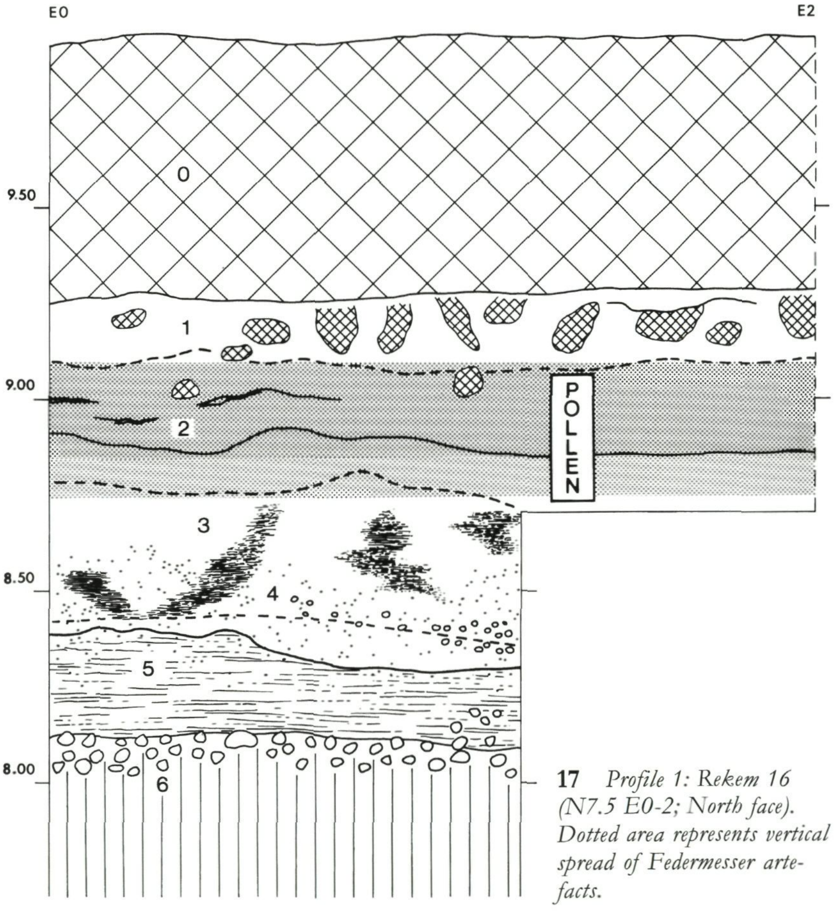
Level 6 (below 8.00m)
- gravels = terrace of Mechelen-aan-de-Maas

Profile 4: Rekem 8 (fig. 19)
S8E17; South face

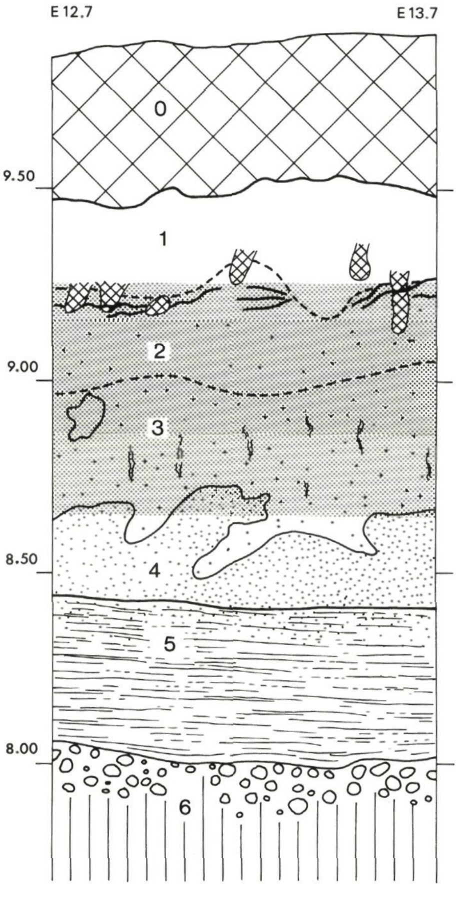
Level 0 (9.75m-9.55m): arable layer
Level 1 (9.55m-9.30m):
- homogenised dark brown mottled sand
- animal burrows filled with material from arable layer, penetrating in bleached layer underneath
- transition to level 2 is irregular, but accentuated by humic accumulation

Level 2a (9.30m-9.10m):
- grey-brown slightly loamy sand with occasional granules and charcoal particles
- diffuse humus illuvation
- relatively homogeneous, except for numerous animal burrows

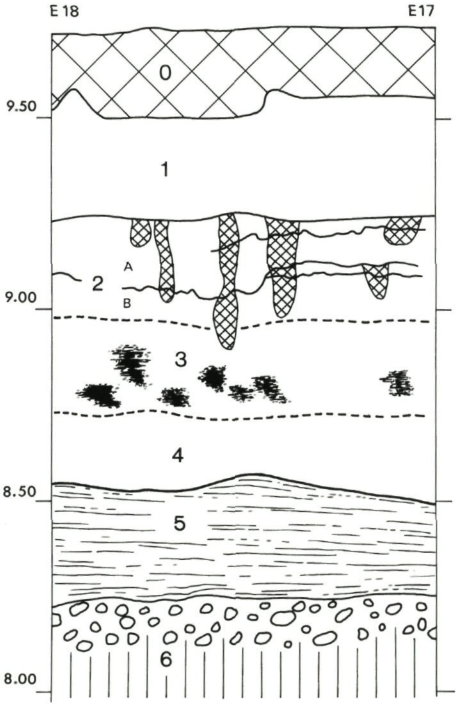
16 *Pedo-stratigraphy at Rekem 1 (profile 5; N10E32), with location of pollen sample column. The upper half of the column corresponds with the vertical dispersion of the artefacts. Near the top of the column, note the bleached horizon (possibly Alleröd soil ?), which becomes darker under the watertable limit.*



17 *Profile 1: Rekem 16 (N7.5 E0-2; North face). Dotted area represents vertical spread of Federmesser artefacts.*



18 *Profile 3: Rekem 5/6 (N10 E12.7-13.7; North face). Dotted area represents vertical spread of* Federmesser *artefacts.*



19 *Profile 4: Rekem 8 (S8.5 E17-18; South face)*

- lower boundary determined by iron fibres

Level 2b (9.10m-8.95m)

- bleached, slightly loamy sand
- weak presence of humus
- sporadic presence of broken granules
- traces of radicells
- Iron accumulation (cf. above) is locally weakly solidified in small patches (∅ max. 3cm), apparently related to underlying consolidations (gley)
- gradual transition to level 3, where finger-shaped structures occasionally penetrate in level 3.

Level 3 (8.95m-8.75m)

- slightly loamy brown-grey sand, homogeneous with fist-size mottles (concentrations of humus enrichment)
- upper and lower boundaries are diffuse

Level 4 (8.75m-8.60m)

- homogeneous slightly loamy greyish sand with sporadic granules (∅ < 3cm)
- scant radicells filled with iron or manganese
- dispersed weak iron concretions, joining the upper level
- boundary at the base is sharp and continuous

Level 5 (8.60m-8.25m)

- probably coversand, but no distinct layering
- clear illuvation of humus and iron, mottled appearance
- sharp upper boundary apparently corresponds with circulation of water

Level 6 (below 8.25m)

- gravels = terrace of Mechelen-aan-de-Maas

2.3.1.2 Synthesis

The general pedo-stratigraphy of the site can be summarised as follows :

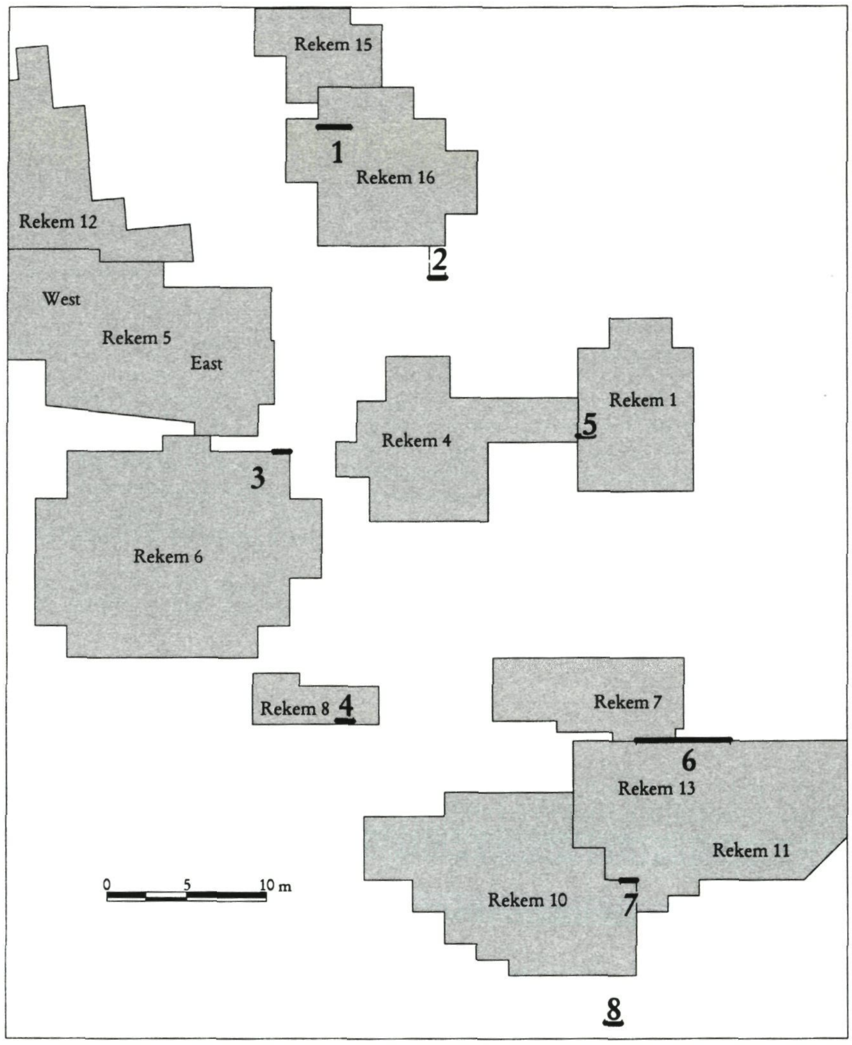
The top of the gravels of the Weichselian Meuse terrace (the terrace of Mechelen a/d Maas) is situated at nearly two meters below the present surface. This terrace is covered with aeolian sands, clearly layered at the base of the profile (coversands). Until the results of the grain size analysis are available, it is not possible to locate the transition to the tardiglacial dune sands. The *Federmesser* artefacts are situated at a depth of ca. 80cm to 100cm below the actual surface (*i.e.* mostly between 9.10m and 8.80m). The material is spread (on average ca. 30cm) in bleached sand, possibly the A2 of a palaeosoil, but which is, to varying degrees, obliterated by recent soil formation processes. Sporadic aeolian (?) granules occur in this layer. The industry is separated from the younger levels by some 20cm of sterile sand. A heavily bioturbated cultural layer (20 to 25cm), dating from the Bronze Age to the Roman period, and clearly enriched by (sub)recent humus infiltration, is truncated by a plough-zone of about 45 to 50cm thick.

2.3.1.3 Assessment of non-anthropogenic disturbance

The general topography of habitation zone 1 at the time of occupation must have been rather flat. At all loci, the artefacts are generally situated between 9.10m and 8.80m. Given its position in eolian sands, this vertical dispersion is not unexpected, and may be ascribed to post-depositional bioturbation. However, the degree of dispersion varies considerably from one archaeological unit to another. Post-abandonment factors of biogenetic origin, as well as on-site agencies such as trampling, are deemed responsible for this. The impact of trampling, or the general systemic disturbance of the sand (stake holes, cooking pits, hearths, etc.), is plausible. This is because differences coincide with the different types of time- and space-use which we assume these concentrations represent, *i.e.* with increasing vertical dispersal on more intensely occupied domestic sites (see chapter 6). In addition, human presence and the discard of organic material within these habitation sites may have stimulated post-abandonment biotic activity. Traces of major disruptive natural events (such as tree-falls or large burrows), were not observed at the level of the artefact dispersion. More detailed accounts of the vertical artefact scatter, as well as of specific anomalies observed within each of the various loci, are reported in chapter 6.

2.3.2 Palynology

In 1984 and 1986, pollen samples were taken by A.V. Munaut[7] in a profile and under large stone slabs at Rekem 1 and as a bulk sample at Rekem 16. The results are given below (manuscript received in 1988).



20 *Location of stratigraphic profiles (1-8) analysed at Rekem habitation zone 1.*

2.3.2.1 Les echantillons

Profil 1984
Un profil vertical continu (60 cm) a été prélevé à travers une concentration de silex (Rekem 1). Sept échantillons superposés d'un poids de 50 gr distants de 10 cm, ont été extraits et préparés par les méthodes classiques de flottation sur liquide lourd. Au total 122 grain de pollen ont été extraits.

Pierres de foyer 1984
Pour évaluer l'impact d'une pierre de dimension décimétrique sur le continu d'un assemblage pollinique sous-jacent (blocage de la filtration), un échantillon a été prélevé immédiatement sous trois pierres ayant probablement appartenu à un foyer (Rekem 1; 21, 22 et 23 grains de pollen ont été respectivement recueillis).

Echantillon 1986
Un kilogramme de sable a été prélevé en vrac au centre d'une couche riche en silex (Rekem 16). La totalité de l'échantillon a été progressivement traitée par NaOH, décantation dans l'eau et centrifugation de la fraction liquide. Quarante-deux grains ont été recueillis.

2.3.2.2 Les resultats analytiques

Quelle que soit l'origine, les assemblages polliniques sont homogènes. Afin d'obtenir des résultats statistiquement plus stables, les résultats d'analyse ont été globalisés en un seul spectre comprenant 230 pollens et spores (Table 4).

Le pourcentage total des plantes arborescentes atteint 59,1 %. Parmi les arbres, *Betula, Pinus* et *Salix*, représentatif des forêts boréales claires peu thermophiles, représentent 27,4 %; les taxons tempérés, 13,4 %.

Comparés aux pourcentages obtenus uniquement sous les pierres (66 pollens), les valeurs relatives sont peu différentes: herbacées 56%, arbres boréaux 22,8%, tempérés 15,2%.

[7] Laboratoire de Palynologie, Université Catholique de Louvain-La-Neuve.

Table 4
Rekem 1984-86. Palynological results (A.V. Munaut).

	Profil 1984 (7 niveaux)	Foyer 1984 1	2	3	Echant. 1986 1000 gr.	Total	%
Alnus	8	-	-	1	2	11	4.8%
Betula	16	4	3	4	5	32	13.9%
Carpinus	1	-	-	1	-	2	0.9%
Corylus	5	-	1	2	-	8	3.5%
Fagus	-	-	-	-	-	0	
Fraxinus	1	-	1	-	-	2	0.9%
Picea	-	-	-	-	-	0	
Pinus	19	4	2	2	3	30	13.0%
Quercus	2	1	1	-	-	4	1.7%
Salix	-	-	-	-	1	1	0.4%
Tilia	-	-	1	1	2	4	1.7%
Ulmus	-	-	-	-	-	0	
Total AP	52	9	9	11	13	94	40.9%
Graminées	41	10	9	6	12	78	33.9%
Artemisia	2	-	-	-	2	4	1.7%
Chenopodiacées	2	-	-	1	-	3	1.3%
Composées	1	1	1	1	9	13	5.7%
Plantago Lanc.	1	1	-	-	-	2	0.9%
Rumex acetos	1	-	-	1	2	4	1.7%
Urtica	6	-	1	1	-	8	3.5%
Cyperacées	1	-	-	-	1	2	0.9%
Ericacées	3	-	1	-	2	6	2.6%
Rosacées	2	-	1	1	-	4	1.7%
Dryopteris	9	-	-	1	1	11	4.8%
Polypodium	1	-	-	-	-	1	0.4%
Total NAP	70	12	13	12	29	136	59.1%
Total	122	21	22	23	42	230	100.0%

21 *Rekem 7. Discovery of curved backed point (turned over on its dorsal face), and adhering resin (black,* in situ*). Length of point is 58 mm.*

2.3.2.3 Discussion

La prédominance des plantes steppiques et des lieux ouverts ne permet pas d'attribuer à l'Holocène le spectre global. Par contre, l'importance relative de *Pinus* et *Betula* exclut un épisode pléniglaciaire. On peut en conclure qu'il s'agit d'un stade à steppe arborée appartenant au Tardiglaciaire. L'équivalence de *Pinus* et *Betula* incite à voir un stade final de cette période intermédiaire, probablement le Dryas III.

La somme (13,4%) des arbres tempérés n'est cependant pas caractéristique du Tardiglaciaire de Campine tel qu'il est mis en évidence dans les sédiments tourbeux[8]. Il faut donc admettre qu'une part de l'assemblage est constituée de pollens holocènes infiltrés à travers la couverture sableuse. Cette part n'est pas minime, mais ne perturbe pas les conclusions générales biochronologiques.

On peut signaler qu'à Saponay (Tardenois, France), le sol d'Ussello enseveli sous une dune sableuse tardiglaciaire épaisse de 320 cm contient 60% d'arbres; 48,2% de taxons boréaux et 12,5% de tempérés[9]. Cette valeur s'accorde avec celle trouvée pour les arbres tempérés de Rekem.

La dimension des pierres de foyers semble insuffisante pour empêcher ce phénomène d'infiltration.

2.3.3 Absolute dating

The absolute chronology for the site rests on both radiocarbon and thermoluminescence dating[10].

2.3.3.1 Radiocarbon dating

Residual resin attached to a curved backed point from Rekem 7[11] (fig. 21) provided a 14C date of 11,350 ± 150 BP (OxA-942), which may obviously be considered an acceptable measurement. After calibration[12], this becomes 11,315 ± 175 cal BC. On the other hand, charcoal submitted for radiocarbon dating proved to be unreliable. Four radiocarbon dates on charcoal samples from two different loci (Rekem 5, and Rekem 10), range form 9,900 ± 110 BP to 2,230 ± 70 BP (Table 5). Although no arguments were found in the field to contradict the association of the charcoal with the lithic industry, the enormous range of the dates and the considerable deviation from the firmly associated resin date indicate that the charcoal must have been intrusive. The

8 Paulissen & Munaut 1969.
9 Vermeersch, Munaut & Hinout 1973.
10 For their kind collaboration, we thank Dr. J.A.J. Gowlett and Dr. R.A. Housley from the Radiocarbon Accelerator Unit, as well as Dr. J. Huxtable and Dr. M.J. Aitken, all from the Research Laboratory for Archaeology at Oxford University.
11 Lauwers 1985a.
12 Stuiver & Reimer 1993; Street *et al.* 1994.

only date which seemed to approach a Late Glacial age (Oxa-945), was subsequently tested by AMS-dating of another piece of charcoal from exactly the same spot (OxA-1375); it showed that this was also intrusive[13]. At Rekem, the later occupation in the same area was indeed intense (from the Neolithic up to the Middle Ages), and the soil matrix of loose sands is heavily homogenised by recent soil formation and bioturbation (see section 2.3.1). In all, the results reconfirm the difficulty of obtaining accurate charcoal dates on Late Glacial open sites (see also section 1.2).

With the resin date, Rekem is the first *Federmesser* site of the Belgian Lowlands to be 14C-dated to the Late Glacial and more specifically within the Alleröd Interstadial (fig. 22). This is in general agreement with the chronology for other *Federmesser* sites in NW-Europe[14].

Table 5
Rekem 1984-86. Radiocarbon dates (AMS, uncalibrated).
(see also Gowlett *et al.* 1987)

Locus	Age (BP)	Lab No	Identification of sample
Rekem 5	2230 ±70	OxA-943	Charcoal fragment amid stones of destroyed hearth
Rekem 10	5220 ±100	OxA-1375	Charcoal associated with retouch flakes (from same spot as OxA-945)
Rekem 5	6390 ±100	OxA-944	Charcoal fragment amid stones of destroyed hearth
Rekem 10	9900 ±110	OxA-945	Charcoal associated with retouch flakes (from same spot as OxA-1375)
Rekem 7	11350 ±150	OxA-942	Resin attached to curved backed point

22 *Radiocarbon dates of Federmesser sites in Flanders (1 σ).*

2.3.3.2 Thermoluminescence dating

Thermoluminescence dating of burnt rock samples confirms a Late Glacial age, with a weighted mean of 12.2 ± 1.1 ka. (Ox88TLi-246; Table 6). The dated samples consisted of 8 quartzite cobbles, each bearing clear traces of fire-use (splintered, rubified), which came from scattered hearths in three distinct loci (Rekem 1, Rekem 5, and Rekem 6; Map 16-18).

TL dates from *Federmesser* assemblages are still rare. Three dates on burnt flint from Meer IV range from 11.5 ± 1.2 ka to 12.4 ± 1.6 ka[15] and are thus very similar to the results at Rekem. At Niederbieber, a TL date of 13.0 ± 1.1 ka has been reported[16]. The Late Upper Palaeolithic site at Hengistbury Head has yielded an average TL age of 12.5 ± 1.15 ka[17]. Both Meer IV and Hengistbury Head have produced equally highly deviating 14C dates on charcoal, which again emphasises the fact that charcoal dates from Late Glacial open sites in a sandy environment with complex taphonomic histories and with considerable potential for contamination[18], should be regarded with great caution. Further comments on the chronological aspects of the Late Palaeolithic in NW Europe were provided in section 1.2.

As for Rekem, while the overall age seems reasonably established, absolute dating clearly cannot be relied upon in the discussion of the site's internal chronology.

2.3.4 Other analyses

2.3.4.1 Phosphate

At Rekem 1, Rekem 5, and Rekem 6, 28 soil samples were taken for phosphate analysis across the artefact scatters. These were taken at the level of the large rocks (sandstones and quartzites), and of the highest artefact density. The analyses were carried out by H. Bosmans[19], using the method established by Dick and Tabatabai (1972).

[13] Communication from Rupert A. Housley in a letter addressed to Robert Lauwers, June 7 1988: "*This date does show that younger charcoal is intruding into the RE-10 concentration and might suggest that OxA-945 is a minimal estimate of age.*"
[14] Street *et al.* 1994; Barton & Roberts 1996; Lanting & Van Der Plicht 1996; Fagnart 1997.
[15] Charles 1994a.
[16] Bolus 1992, 19.
[17] Barton 1992.
[18] Housley 1991.
[19] Laboratorium voor Analytische en Minerale Scheikunde, Katholieke Universiteit te Leuven.

Table 6
Rekem 1984-86. TL dates.
(for further details see *Ancient TL supplement Date List 2*, December 1988)

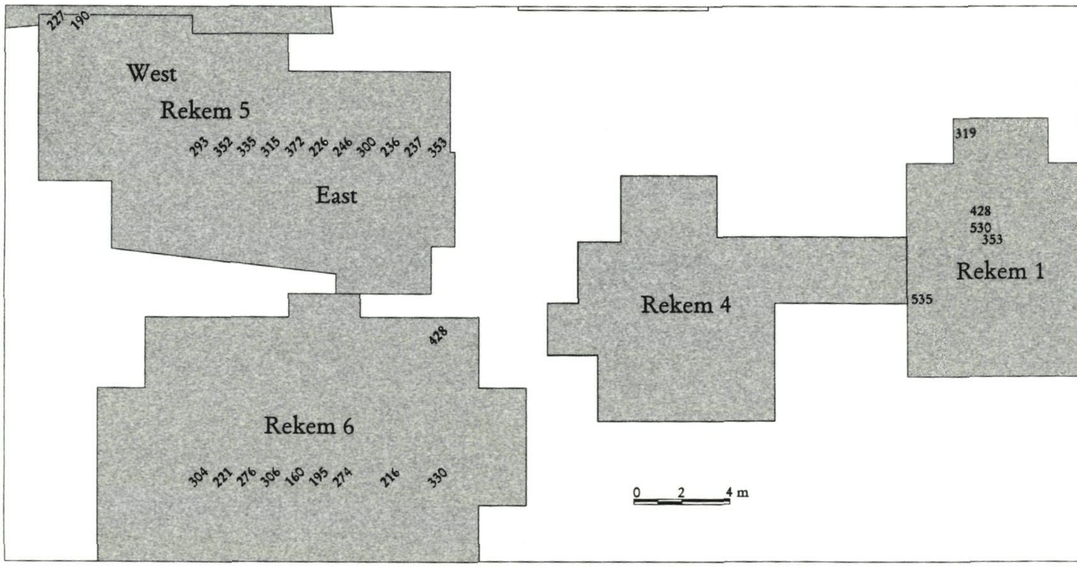
Locus	Age (BP)	Lab No	Identification of sample
Rekem 6	11100 ±1200	Ox88TLi-246c10	Quartzite pebble RE6/2-4/10=sample 10
Rekem 1	11600 ±1200	Ox88TLi-246a1	Quartzite pebble RE1/8-34/5=sample 1
Rekem 6	11800 ±1200	Ox88TLi-246c8	Quartzite pebble RE6/2-6/139=sample 8
Rekem 6	12100 ±1300	Ox88TLi-246c7	Quartzite pebble RE6/2-6/136=sample 7
Rekem 5	12300 ±1400	Ox88TLi-246b3	Quartzite pebble RE5/18-0/212=sample 3
Rekem 5	12600 ±1400	Ox88TLi-246b6	Quartzite pebble RE5/18-4/62=sample 6
Rekem 6	13000 ±1400	Ox88TLi-246d11	Quartzite pebble RE6/-0-12/2=sample 11
Rekem 6	13000 ±1500	Ox88TLi-246c9	Quartzite pebble RE6/2-6/167=sample 9
Rekem (average age)	12200 ±1100	Ox88TLi-246	Quartzite pebbles

It was hoped that concentrations would be revealed in the centre of the presumed dump spot Rekem 1, and in the habitation zones of Rekem 5 and Rekem 6. However no significant variation could be observed. All P values range between 160 ppm and 553 ppm, and do not reveal any signi-ficant patterning (fig. 23). Only at Rekem 6 can a slight increase be detected towards the edges of the artefact concentration. This is a phenomenon that has been more clearly observed at the Mesolithic site of Brecht-Moordenaarsven 2, where it was interpreted as the result of a midden near peripheral hearths[20]. In all, the phosphate analysis could not support the assumption that more organic material had been left within the large habitation sites (section 2.3.1.3).

2.3.4.2 *Resin*

Most of the resin (0.20 - 0.25 g.), found on the curved backed point of Rekem 7 (fig. 21), was used to date the sample (see above). A small part (5 x 5 x 1 mm), however, could be preserved for the analysis of possible additives (red ochre, beeswax, ...). Both röntgen-diffractometry and infrared spectrometry were undertaken by H. Kars[21] at the '*vakgroep Chemische Geologie*' of the Institute of Earth Sciences, Rijksuniversiteit te Utrecht, to determine the composition of the sample. However, except for the presence of quartz[22] and some humic acid, both ascribed to an accidental admixture of the sediment, no signs of possible additives could be detected.

23 *Values of phosporus (in ppm) on various locations at Rekem 1, Rekem 5, and Rekem 6.*



[20] Bosmans in Vermeersch, Lauwers & Gendel 1992, 55.
[21] Rijksdienst voor het Oudheidkundig Bodemonderzoek, Amersfoort, the Netherlands.
[22] It cannot be excluded that quartz (sand) was also intentionally added to the resin.

Because the infrared spectrum was characteristic of fossil resin, it was suggested that the sample had probably been affected by fire. As shown by experiments (see chapter 5), heating is indeed needed to soften resin when it is to be used as an adhesive.

2.4 Discussion : hunter-gatherers in an Alleröd landscape

Like at most prehistoric sites in sand, very little conclusive evidence could be gained at Rekem for the contemporary natural environment and the subsistence base of the Late Palaeolithic inhabitants. We are confronted with a poor pedo-stratigraphical resolution (but possibly an association with remnants of a palaeosoil), a lack of faunal remains, the poor preservation of pollen (but seemingly a Late Glacial context), and problems with intrusive charcoal for dating. Still, from the resin date, and supporting information from other analyses (TL, palynology, stratigraphy), it may be safely concluded that *Federmesser* occupation at Rekem was situated in the Alleröd Interstadial.

In the immediate area, there are no sites of this age with adequate palaeo-ecological data. However, given recent evidence from the extensive environmental studies in Northern France and Germany (Northern Rhineland) the following picture of the natural environment during the Alleröd can be reconstructed (if only in this part of NW Europe).

In Northern France, the Alleröd environment is characterised by the development of an open forest with stands of birch (*Betula*) and, towards the end of the Interstadial, pine trees (*Pinus*). The large fauna are represented by aurochs (*Bos primigenius*), red deer (*Cervus elaphus*) and, occasionally, horse (*Equus caballus gallicus*)[23].

In the central Rhineland, the landscape was characterised by a vegetation mosaic in which there were stands of trees, of different composition according to topography and hydrology and in places with dense undergrowth. These alternated with more open areas having rich herbaceous vegetation. A wide range of animal species included red deer (*Cervus elaphus*), horse (*Equus sp.*, roe deer (*Capreolus capreolus*), a large bovid (*Bos primigenius*?), moose (*Alces alces*), beaver (*Castor fiber*), bear (*Ursus arctos*), wolf (*Canis lupus*) and red fox (*Vulpes vulpes*). Fish species included pike (*Esox lucius*) and perch (*Perca fluviatilis*) while black grouse (*Tetrao tetrix*) was identified among the bird remains[24].

If most of this ecological evidence may also be accepted for the Meuse valley, it may be concluded that the subsistence economy for the *Federmesser* groups would be based on large mammals which would be present in the territory at low density, but on a year-round basis. The periodic exhaustion of short-range resources around the human settlements may thus have instigated regular displacement (high residential mobility). In addition, the availability of a range of smaller mammals, fish species and birds, as well as various plant resources[25], may have contributed to a fairly balanced diet for these people.

23 Fagnart 1997.
24 Street 1993; Baales & Street 1996.
25 Leroi-Gourhan 1997.

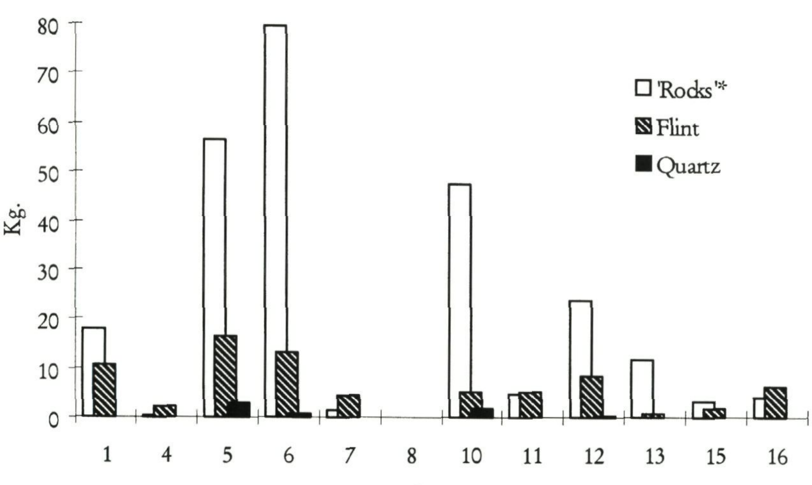
3 Non-flint Rocks and Minerals: Structural Elements and Tools

3.1 Introduction and general inventory

Along with the flint assemblage, which will be discussed in the next chapters, a range of other lithic remains, mostly sandstone blocks, quartzites, and quartzes further referred to as 'rocks' were recovered at Rekem. In addition, most loci also contained some red ochre. The large majority of these rocks had been transported to the larger loci lined up in the western half of habitation zone 1 (Rekem 5, 6, 10, and 12; Map 5, 7, 10 & 13). At these locations, the rocks are generally mixed with abundant flint material, though the latter occurred on a somewhat lesser scale at the (presumed) dwelling of Rekem 10. A lesser presence of rocks has been observed at the (spatially) small scatters of Rekem 1 and Rekem 13, where the distribution of flint and rocks appeared at least partly separated (Map 2-3 & 12).

The total amount of lithic and mineral remains found at each of the distinct loci at habitation zone 1 can be read from Table 7 and fig. 24. Altogether, nearly 260kg of non-flint rocks had been transported to this part of the site. Nearly 80% of these are quartzites, less than 20% is composed of sandstones. Rare miscellaneous stone types and quartz cobbles represent about 2% of the rocks. For comparison: a total of some 75kg of flint had been brought to and worked at the same habitation zone (see chapter 4).

None of these raw materials occur naturally on the surface of the Late Glacial sandy elevation, and it may therefore safely be accepted that even unmodified items in the *Federmesser* level had been intentionally carried here by man (so-called manuports). No doubt most mineral remains, except for the imported haematite (less than 1/2 kg.), could be collected locally. They may have been transported only a very small distance, taken from spots where the Meuse river-terraces were exposed by erosion, or from the riverbed itself, which lay only a few hundred meters



24 *Rekem, habitation zone 1. Weight of mineral remains by locus. *'Rocks' are mainly quartzite and sandstone.*

Table 7
Rekem habitation zone 1. Weight inventory of all lithic and mineral remains by locus (in kg).
* 'Rocks': all lithics except flint and quartz (i.e. essentially quartzites and sandstones).

	Locus 1	4	5	6	7	8	10	11	12	13	15	16	Total	%
'Rocks'*	17.87	0.20	56.70	79.74	1.60	0.00	47.36	4.80	23.77	11.80	3.30	3.90	251.04	76%
Quartz	0.02	-	3.00	0.72	-	-	1.78	0.10	0.24	-	-	-	5.86	2%
Red ochre	0.05	0.07	0.08	0.02	0.01	-	0.01	0.06	0.09	-	-	0.03	0.43	0%
Flint	10.59	2.08	16.44	13.00	4.53	0.13	4.95	5.01	8.56	0.79	1.98	6.14	74.20	22%
Total	28.53	2.35	76.22	93.48	6.14	0.13	54.10	9.97	32.66	12.59	5.28	10.07	331.53	100%

away. Only one specific type of rock, a coarse-grained iron sandstone, presumably tertiary 'Diestiaan', is not known to occur in the immediate neighbourhood. Its nearest natural outcrops today are situated some 30 km to the West. There has been no attempt to define the original natural sources of the haematite. Outcrops of this material are present along the Meuse, incorporated in Famenian-age psamites (Dumont 1832). The Ardennes and the Eifel region are other possible candidates. Together with the iron sandstone, the occurrence of this raw material points to procurement over longer distances. Both imported raw materials were presumably also used for very specific purposes (the "Diestiaan" sandstone, for example, being made into grooved polish stones; Pl. 2: 5, Pl. 6: 1-2; section 3.2.2).

3.2 Quartzites, sandstone, quartz

3.2.1 Raw material selection

A first glance at the overall morphology of the rocks, when compared with the contents of the local gravels, shows that a certain selection occurred at the natural resource. This may be illustrated by the detailed observations on the rocks of Rekem 6[1]. The bulk of the material at this locus is composed of different types of quartzite (ca. 86%), the rest comprises mainly sandstone, some rare conglomerates and a few sparse quartz cobbles (less than 1%). The anthropogenic selection here had clearly been directed towards fairly large and, above all, distinctly flat rocks. At Rekem 6, nearly 73% of all rocks are such flat slabs, with overall dimensions of between 20 x 15 x 2.5 cm and 10 x 6 x 5 cm. Such a choice may reflect some constraints of transport, but it might also be linked with intended future uses of these stones (see below). Voluminous, thick blocks are rarely encountered (ca. 14%), while the presence of a fairly consistent group (13%) of small spherical (ca. 5 x 5 x 3 cm) or small elongated cobbles may point again to a deliberate choice. In fact, this category includes most of the hammerstones and quartz cobbles (Pl. 1: 1-4, Pl. 2: 1-4). The same general morphologies are equally found at the other loci. However, their numeric importance shows significant variation from one structure to another.

Very few mineral remains had been left unmodified. Severe physical alteration has been caused by fire, essentially expressed by the high degree of fracturing among these remains. Apart from this, though often concerning the same items, a great deal of these manuports shows traces of specific use as individual tools and have often been intentionally modified to that purpose.

3.2.2 Rocks as tools

At Rekem, the majority of lithic tools are obviously made from flint (chapter 5). However, for some functions, as *e.g.* hammerstones, "*retouchoirs*" or grooved "polishers", as well as for a range of more heavier tasks, the use of other lithic raw materials (mainly quartzite and sandstone), was probably more appropriate. At habitation zone 1, the number of such tools made of rocks other than flint is exceptionally high for a *Federmesser* context. Their relative importance in the lithic toolkit may have been stimulated by the abundance of and easy access to these raw materials, but may equally be related to the nature of the site (or at least part of it). The common characteristic that separates rock tools from flint tools is their large and/or heavy morphology. On a techno-morphological basis, different groups can be distinguished (summarised in Table 8).

[1] The same tendency is observed at the other loci, but no exact counts have been made there.

Table 8
Rekem habitation zone 1. Rock remains as individual tools.
Note: quartzes possibly used as 'cooking stones', and hearthstones, which might equally be considered as part of the functional lithic repertoire, are not included in this list.

	Locus												
	1	4	5	6	7	10	11	12	13	15	16	Total	%
Bifacially trimmed edges ('heavy duty tool')	4	-	9	26	1	12	1	4	7	-	1	65	38%
Rocks with impact traces/random flakes	3	-	15	17	-	14	2	5	2	2	1	61	36%
Hammerstone/*retouchoir*	2	-	5	13	-	6	-	6	1	1	2	36	21%
'Shaft polisher'	-	-	-	1	-	-	-	2	-	-	-	3	2%
Slab with traces of heamatite grinding	-	-	1	-	-	-	-	2	-	-	-	3	2%
Slab with cutting traces	-	-	1	1	-	-	-	-	-	-	-	2	1%
Total N	9	0	31	58	1	32	3	19	10	3	4	170	100%
Total weight (kg)	3.0	0.0	11.6	31.4	0.7	20.4	1.0	12.8	7.1	0.3	2.2	90.5	
% of total weight of mineral remains	17%	0%	19%	39%	44%	42%	20%	53%	60%	9%	56%	35%	

1. The most important category of these tools is that which shows very consistent traces of intentional modification of the artefact edges through flaking. This flaking seems not directed towards the production of flakes but clearly involves the modelling of the edges, as indicated by many refits (see below). Amongst these implements is, first of all, the strictly defined group of *tools with bifacially trimmed edges* (Pl. 3: 1-3, Pl. 4: 2-3). Here the flaking is often intense and more or less continuous, sometimes (on smaller rocks or rock fragments) this retouch is well elaborated and refined. We shall generally refer to these rocks as "heavy duty tools". Obviously, such large, more dull-edged implements may have been adequate for tasks in which size and mass were more important than sharpness or precisely shaped edges (as provided by the flint artefacts). Many chopping, hacking, sawing, or digging functions fit this category. The construction and repair of hide fleshing uprights, smoking racks, shelters, or dwellings could, in the main, be accomplished with such large, simple, and relatively dull-edged tools, which could be made, used, and discarded on the spot. Clearly the identification of these functions still remains largely speculative at this point in time.
2. In addition to these bifacially worked tools is the very large group of *rocks with random impact traces*. Their modification, whether intentional or due to utilisation, is much less advanced and does not basically alter the initial morphology. The randomly dispersed impact traces consist of a few unifacial flakes and/or crushed edges.
3. Another group of stones with impact traces, is the fairly well circumscribed category of *hammerstones* and '*retouchoirs*' (Pl. 1, Pl. 2: 1). They constitute a group of tools with specific characteristics of morphology and weight. An arguable distinction between both types might be made on the basis of dimensions and the degree of the impact traces, but as noted by De Beaune[2], experimental knappers can execute both operations with a single hammerstone. Given their potential significance for the discussion on knapping techniques, these items are presently being studied for a more detailed petrographic analysis, and will be presented more profoundly, together with the results of the (microscopic) analysis of percussion marks on flint blades and flakes[3].
4. A specific type of tool is represented by the three grooved '*polishers*'. These elongated pieces with a hemispherical central groove occur in a coarse-grained sandstone. The dimensions of these pieces are respectively 114 x 34 x 21 mm (Pl. 6: 1), 57 x 43 x 26 mm (Pl. 2: 5, Pl. 6: 2), and 53 x 45 x 27 mm (both the latter are fragments, possibly from a single piece). The grooves are approximately 10mm to 12 mm wide. Traditionally, these pieces are interpreted as 'shaft polishers', *i.e.* items that were used for grinding arrow shafts or other straight rods. Similar specimens have been repeatedly encountered at other *Federmesser* sites[4], but are equally known from other final Palaeolithic or Mesolithic traditions. One fragment at Rekem shows three parallel carvings on one side (Pl. 6: 2) which are reminiscent of the incisions found on a shaft polisher at Niederbieber[5].
5. Finally, there is a group of tools bearing traces of their very specific use such as quartzite plaquettes used for *haematite grinding*, or
6. slabs with *cutting traces* (Pl. 3: 4).

As can be read from Table 8, 'rock tools' were found at nearly all of the loci of habitation zone 1, though most were located in the large areas of Rekem 6, Rekem 5, and Rekem 10. Tools with bifacially worked edges were the most common. At some locations, in terms of weight, more than half of the rocks show clear traces of intentional modification or damage (*e.g.* at Rekem 12, Rekem 13, and Rekem 16).

The value of rock tools for intra-site spatial analysis is closely related to the structural level (section 6.2). These rocks often bear traces of fire, and may in some former or later stage have been engaged in other functions, possibly of a structural importance. Such uses cannot always be read from the physical state of the rocks themselves, but may sometimes be inferred from their spatial configurations. The numerous inter-locus links indicate that these raw materials were also quite mobile within the campsite (seemingly even more so than flint; section 6.4.1), and it would therefore be erroneous to maintain a direct use/discard relationship for these items.

3.2.3 Quartzes used as 'cooking stones'

At all the major 'domestic units', at least some fragments[6] of white quartzes were found (Table 7), totalling some 5.86kg. Although systematic refitting has not been attempted, it is clear that at each of these loci, these fragments generally belonged to only a few cobbles. Refitted quartzes, and one unbroken cobble, indicate an average original size of about 400g. (Pl. 2: 2-4). Their breakages are obviously due to fire, presumably after immersion in water. We will therefore further refer to them as 'cooking stones'. Examples of this stone boiling technique are known from other Late Palaeolithic sites and from ethnographic contexts[7].

3.2.4 Rocks as structural elements

The heavy fragmentation of the rocks presumably results from important use and re-use cycles for many of these objects. When we consider the great number of blocks brought to certain loci as well as their original large sizes, one may think of a structural function (*e.g.* in hearths or dwellings) for many of the mineral remains of this category.

However, at first sight, the spatial scattering of these rocks reflects very little obvious organisation at any of the loci. Indeed, at the last stage of the occupational history, there is very little direct structural evidence left: presumably, between the moment of the arrival of these rocks on site and their final abandonment lies a complex history of use and re-

[2] De Beaune 1989.
[3] Caspar & De Bie, research in progress.
[4] *e.g.* Verheylewegen 1956; Van Noten 1978; Bolus 1992.
[5] Loftus 1982.
[6] Given the small sizes of many of these fragments, it is possible that not all pieces have been recovered from the site.
[7] Batchelor 1979; Dittmann 1990.

Table 9
Rekem habitation zone 1. Volume of rock remains in relation to fire, by locus.
* Weight of burnt blocks includes the small fragments broken by fire.

	Locus											
	1	4	5	6	7	10	11	12	13	15	16	Total
Weight of unburnt blocks	13.8	0.2	14.5	44.5	1.5	18.7	3.4	13.8	1.6	2.5	3.4	117.9
Weight of burnt blocks*	4.1	-	45.2	36.0	0.1	30.4	1.5	10.2	10.2	0.8	0.5	139.0
Total weight of blocks	17.9	0.2	59.7	80.5	1.6	49.1	4.9	24.0	11.8	3.3	3.9	256.9
Portion of burnt blocks (%)	23%	0%	76%	45%	6%	62%	31%	42%	86%	24%	13%	54%

use, breaking up and dispersal (see chapter 1). After the final abandonment of the artefacts, a variety of natural agencies may have continued to move them. If appropriately performed, the refitting of these remains might help to unravel some of this problem (see below). Two features may have especially influenced the intra-locus distribution of these rocks: hearths and dwelling structures.

3.2.4.1 *Hearth-related objects*

On the whole, about half of the rocks at Rekem were affected by fire (Table 9). Their burnt character was appreciated by *de visu* handling, and can be deduced from a number of characteristics on the abandoned rocks. These include occasional, but very typical thermal cupolas on the surface, rubefaction and, most importantly, specific fragmentation. As the (empirical) distinction between burnt and unburned pieces is not always clear-cut, it is likely that a number of rocks that were only slightly altered (or not at all) by fire-use, have not been recognised as such.

The number of small fragments of rocks is sometimes very high. The fragmentation index (F.I.) in Table 10, to be considered as an extreme minimum, gives a rough idea of the degree of breaking which varies greatly among the distinct structures. The refitting results demonstrate that blocks with original dimensions of approximately 30 to 40cm are finally reduced, at the end of the occupation, to a mass of small fragments (Pl. 5: 1-2). That the breakage of the rocks is closely related to heat-treatment, is further shown by the positive correlation between the data in Table 9 and Table 10.

As is known from the study of a large number of Upper Palaeolithic sites, the use of fire, represented at a basic level by the construction of hearths, holds a central significance in the spatial organisation of prehistoric habitations[8]. The palaeoethnographic analysis of the settlement of Pincevent has already led to important conclusions on this matter[9]. However, at Rekem, no such clear and direct evidence has been preserved. Although some arrangements of rocks with a structural significance can be isolated, there are no unequivocal spatial arrangements of rocks which may be interpreted as built hearths, neither are there secondary indications (burnt sediment or carbonised combustion material) preserved at the site to confirm the existence of these features. Although the basic raw material appropriate for the construction of hearths was easily accessible at Rekem, and burnt rocks are indeed abundantly present at the different loci, the clear structural elements are extremely poorly represented when compared with, for example, the Upper Palaeolithic sites

Table 10
Rekem habitation zone 1. Fragmentation index of rock remains by locus.
* N of blocks includes only complete and more than half reconstructed blocks. This should therefore be seen as a minimal count of blocks transported to the site.
** small debris: less than 5 cm diameter (also including quartz fragments).
The fragmentation index is to be considered as an approximate and minimal reference, expressed by the relation: N of small fragments/ N of ca. complete blocks.

	Locus											
	1	4	5	6	7	10	11	12	13	15	16	Total
N of unburnt blocks*	22	1	40	78	4	50	9	15	5	4	9	237
N of burnt blocks*	14	-	61	62	-	61	-	14	14	2	2	230
Total N of blocks*	36	1	101	140	4	111	9	29	19	6	11	467
N of small (burnt) debris**	70	-	1100	155	7	340	27	55	12	-	10	1776
Fragmentation index	1.9	0.0	10.9	1.1	1.8	3.1	3.0	1.9	0.6	0.0	0.9	3.8

8 Olive & Taborin 1989.
9 Cf. Leroi-Gourhan & Brezillon 1972, 84: '*... les trois grands foyers jouent le rôle de pôle d'attraction pour une grande quantité de vestiges...*'.

Table 11
Rekem habitation zone 1. Refitting results for non-flint rocks.
* Fragments of the 'source' locus are obviously not counted here; hence, this value represents the absolute number of inter-locus links.

	Locus 1	4	5	6	7	10	11	12	13	15	16	Total	%
Unrefitted rocks													
Complete block	22	-	42	54	2	41	6	9	3	4	9	192	
Large fragment	13	1	256	26	2	16	3	11	8	1	2	339	40%
Small fragment	30	-	200	85	14	120	26	15	9	1	9	509	60%
Total unrefitted fragments	43	1	456	111	16	136	29	26	17	2	11	848	100%
Rocks in intra-*locus* refits													
Burnt fragment	55	-	235	151	2	130	11	22	14	-	3	623	87%
Unburnt fragment	-	-	13	16	-	13	-	2	3	-	2	49	7%
Intentional flake	6	-	8	14	-	14	-	1	-	-	-	43	6%
Total N refitted fragments	61	-	256	181	2	157	11	25	17	-	5	715	100%
Rocks in inter-locus refits													
N fragments refitted to other locus*	-	-	13	13	-	5	-	5	3	-	-	39	
Total N of fragments	104	1	725	305	18	298	40	56	37	2	16	1602	
Refit quotum: % refitted fragments	59%	0%	37%	64%	11%	54%	28%	54%	54%	0%	31%	47%	

of the Paris Basin[10]. As shown by the refitting, the (prolonged?) use or re-use of the fireplaces at Rekem seems to have led to the removal of burnt rocks and fragments, and finally to the complete dismantling and disappearance of the original structure. In fact, it would be erroneous to consider hearths as completely static features. Detailed analysis of the hearths at Pincevent has shown that these were constantly modified, dynamic structures[11].

On the other hand, it may well be that well-built hearths never existed at Rekem, and that the concentrations of burnt rocks are primarily the result of the use of these objects for meat roasting, the melting of resin, as 'cooking stones', or as a means to take optimum advantage of the heat source, by progressive accumulation and re-diffusion of warmth[12]. In fact it has been noted in ethnoarchaeological studies that circular arrangements of stones impede the multi-purpose use of a hearth[13]. Conversely, flat slabs used for meat roasting (or resin melting) could simply be placed on top of hot charcoal. When they were not in use, these stones could also be kept out of the fire, and 'stored' for future use in an area some 1-3 m. away from the hearth (as frequently observed at Pincevent[14]).

Finally, it should be stipulated that even if the construction of hearths was not a systematic practice at Rekem (and in fact, to our knowledge, there are no examples of well-built hearths in any *Federmesser* context), it may nevertheless still be possible that many hearths did exist at the site; they may have simply become invisible since neither charcoal nor other distinctive traces are preserved. In particular, the isolated debitage scatters in the eastern half of habitation zone 1 may have been accompanied by so-called satellite hearths (as *e.g.* observed at Etiolles[15]). Recently, a spread of numerous small fireplaces has been attested at the well-preserved *Federmesser* site of Le Closeau (Rueil-Malmaison[16]).

3.2.4.2 *Dwelling structures*

An entirely different spatial pattern of mineral remains has been observed at Rekem 10. At the western part of this locus, almost all the larger blocks occupied an eccentric position, ultimately displaying a (semi)circular pattern (see section 6.2.6.2). Rocks observed in such circular configurations have often been interpreted as structural features used to weigh down a tent cover[17]. While this may be the case for some of the larger boulders amongst them, we do not think that all these rock remains had a primarily structural function at Rekem 10. They may have been removed from a more central position and their distribution may ultimately have been influenced by a circular construction of which no evident traces are left. Several additional arguments for the presence of a (closed) dwelling at Rekem 10 are provided in section 6.2.6.

3.2.4.3 *Note on refitting of rocks*

As noted above, the fragmentation of the rock remains at Rekem is generally intense. Naturally, the degree of fracturing is very different from one structure to another and it is important to attempt to measure and express accurately the impact of this 'destructive' factor. This can only be done after the precise recording and conservation of even the smallest fragments in this category. For example, inten-

10 Julien *et al.* 1988.
11 Valentin 1989.
12 Compare Leesch 1997, 170-171.
13 *e.g.* Janes 1989, 131.
14 Julien 1988.
15 Olive 1992.
16 Bodu 1995.
17 *e.g.* Arts & Deeben 1983.

Table 12
Rekem 1984-86. Inventory of ochre fragments by locus.

	Locus										
	1	2	4	5	6	7	10	11	12	16	Total
N of polished fragments	4	1	3	8	3	1	4	1	3	1	29
Total N of fragments	6	3	3	18	4	1	7	1	3	3	49
N of fragments after refitting	6	3	3	17	3	1	7	1	2	2	45
Total weight (in g.)	53.1	12.0	74.0	77.4	24.2	6.0	13.3	56.0	93.0	31.0	440.0

tional retouch flakes are among the smallest of the rock artefacts, but they have a high intrinsic value and are of great help in defining and locating certain activities. Next, a detailed macroscopic examination should attempt to reveal the causes of breakage: fire-cracked, (random) use damage or (advanced) intentional flaking. These are the most consistent and characteristic groups that can be isolated among the rock remains. Quantitatively, smaller rock fragments are often more important than larger blocks. At Rekem, we considered a maximum length of 5cm to be representative for such small fragments. Since they only rarely show clear traces of intentional flaking (bulb of percussion), the bulk can be considered as fire-caused breaks.

In contrast to the refitting of the flint artefacts (chapter 4), especially when dense scatters of flakes are under study, the refitting analysis of the rock remains can generally be considered as more or less exhaustive. The physical variation between these remains is usually sufficient to allow the quick recognition of related fragments. The inclusion of all the small fragments into the refitting objective is often not only unrealistic, but in some instances the refitting of certain rock debris would also have only a very low interpretative value (*e.g.* the small debris of burnt quartzes).

As with the flint conjoinments, it is important to determine the obtained refit quotum. While attempts have been made to clarify the different ways of quoting the refitting results for flint remains[18], a simple and direct refit quotum specifically for rock remains has not yet been established. Clearly this is of an entirely different nature and value. Significant interpretation can be drawn from the fact of whether it is causally linked with fire, manufacture or use (both the latter breaks are not easily distinguished). An attempt for cataloguing and quoting the various types of rock refits at Rekem is illustrated in Table 11. Because of their importance for the overall site interpretation, a distinction has also been made between inter- or intra locus refits.

As can be read from this table, refit quota are quite high (*i.e.* from 54% to 64%) in the large 'domestic units' of Rekem 6, Rekem 10, and Rekem 12. At Rekem 5, the score is somewhat lower (37%), but it should be noted that this locus contains by far the highest number of fragments. Good scores were also obtained at Rekem 1 and Rekem 13. Far fewer fragments could be refitted at the other small loci. Especially at Rekem 15, Rekem 7, and Rekem 11, the fragments seem either to have been imported as such, or are the result of trimming, assuming that the rock tools were subsequently removed.

As the connections between non-flint rocks mostly lack a clear direction, the graphical presentation outlined for the flint refits could not be instantly adopted for the rocks. In the case of intentional flaking, the same principles could be followed (*i.e.* connection lines with an arrow towards the 'core' or 'tool'). However, the large majority of break refits had to be treated differently. In most cases, the smallest fragments are generally directly connected with the more encumbrant remains. Only when successive breaking could be established is this sequence normally presented. The detailed patterning of the spatial output of the refitting evidence is discussed in chapter 6.

3.3 Haematite

In addition to the field observations of ochre in powder form, 49 fragments of red ochre (totalling 440g) have been collected from Rekem. They were present in most of the loci (Table 12).

These fragments range from 6mm to 79mm across, i.e. from tiny fragments to a slab of 56g (Pl. 6: 3). A majority of the fragments (N=29) display at least one polished facet. Some are shaped like true pencils (Pl. 2: 6, Pl. 6: 6), others as plaquettes (Pl. 6: 3). Eight fragments could be refitted in a fracture (*e.g.* Pl. 2: 7, Pl. 6: 5), all as intra-locus refits. At present, there is neither evidence for the precise function of these elements, nor for their potential roles in the working of other materials.

18 Cziesla 1992a; see also chapter 4.

4 Production of blanks: flint knapping technique and reduction methods

4.1 Introduction

4.1.1 Goals, methods, approach

In an attempt to reframe 'static' lithic assemblages in the dynamic context of the human past, the focus of many present-day lithic studies is on the reconstruction of the complete *chaîne opératoire*[1] of the lithic technology under consideration. Such an approach includes an examination of the techniques and methods of knapping and tooling, but it equally involves the elucidation of processes related to raw material procurement, use, and discard. Rather than merely describing and classifying the artefacts, the goal – in general terms – is to reconstruct (partly by reproduction) and to explain the behavioural processes behind the formation of the lithic record.

These processes must not be limited to a purely technical dimension, but should also cover economic (*e.g.* 'cost/benefit', 'productivity') or even social aspects of human behaviour. Since technical know-how is transmitted in a social context[2], technical features are indeed integral characteristics of the material culture of the group at issue. It may be assumed that knapping techniques and methods, being only indirectly related to function, and transmitted from generation to generation by extragenetic social memory[3], are in fact good indicators of socio-cultural affinities. On the other hand, the act of flintknapping, like handwriting, doubtless comprises an individual dimension, an aspect that likewise has to be kept in mind.

With almost 25,000 flint artefacts, the site of Rekem provided an excellent data base for an elaborate technological analysis. Extensive refitting, detailed attribute analyses, use-wear studies and spatial analyses, have all contributed to a better understanding of the site formation and the assemblage variability.

This chapter presents aspects of lithic reduction strategies, *i.e.* the processes that lead from the procurement of a block of raw material to the final abandonment of the exhausted core, or in other words the transformation of a block of stone into 'suitable' blanks. Chapter 5 will focus on the 'consumption' of these blanks, *i.e.* tool manufacture, maintenance, use, and discard. Both chapters are of course closely related, and constitute the basic data for the spatial analyses presented in chapter 6.

Two major sources of information have been confronted and combined to study the technique and organisation of flint reducing activities at Rekem. From a static perspective, the general inventory of debitage products and cores, and their morphological characteristics provided an overall impression of the techniques and methods applied. In a dynamic perspective, on the other hand, the detailed analysis of the numerous refits generated information on the organisation of the reduction process and on the technical knowledge and know-how of the flint knappers that had worked at Rekem. To a certain degree, it also questioned some interpretations which would have been gained from a 'static analysis' alone, *i.e.* without the benefit of the insights obtained from the refits.

In overall terms, the emphasis of this chapter is on the *organisation* of the debitage, i.e. the knapping *method(s)*[4], much less than on the knapping *technique(s)* (*i.e.* type of hammer, modalities of percussion, etc.). Distinguishing the latter aspect requires extensive experience of experimental knapping, a skill we have not (yet) acquired. A project that will specifically focus on types of percussion and the nature of the hammers, partly based on microscopic observations, and in collaboration with experienced knappers, is presently being designed (Caspar & De Bie, research in progress). From our current observations, however, it seems that flint knapping at Rekem was largely dominated by direct hard hammer percussion throughout all the reduction process.

4.1.2 Glossary of terms related to debitage and refitting

As rightly stated by Brézillon (1968), any reading of archaeological material would be pointless if not followed by exchange and communication. Therefore, we have attempted to adopt 'conventional' terminology, largely based on definitions proposed earlier in the literature[5]. Some terms, however,

1 Pelegrin, Karlin & Bodu 1988; Julien 1992; Sellet 1993; Valentin 1995.
2 Pigeot 1990.
3 Roux 1990.
4 Cf. Inizan, Roche & Tixier 1992, 34: '*The term method implies an elaborate conceptual scheme. A knapping method is a sequence of actions leading to the manufacture of predetermined products.*'
5 *e.g.* Pigeot 1987; Cziesla 1990a; Inizan, Roche & Tixier 1992; Van Peer 1992a.

might benefit from more explicit clarification and they are defined below. Some definitions are also supported with illustrations (fig. 25 & fig. 26). Reduction, by definition, is evidently a dynamic event. It should therefore be emphasised that the function of surfaces on a volume being reduced can change throughout a reduction sequence (*e.g.* core tables can become striking platforms and vice versa).

Refitting

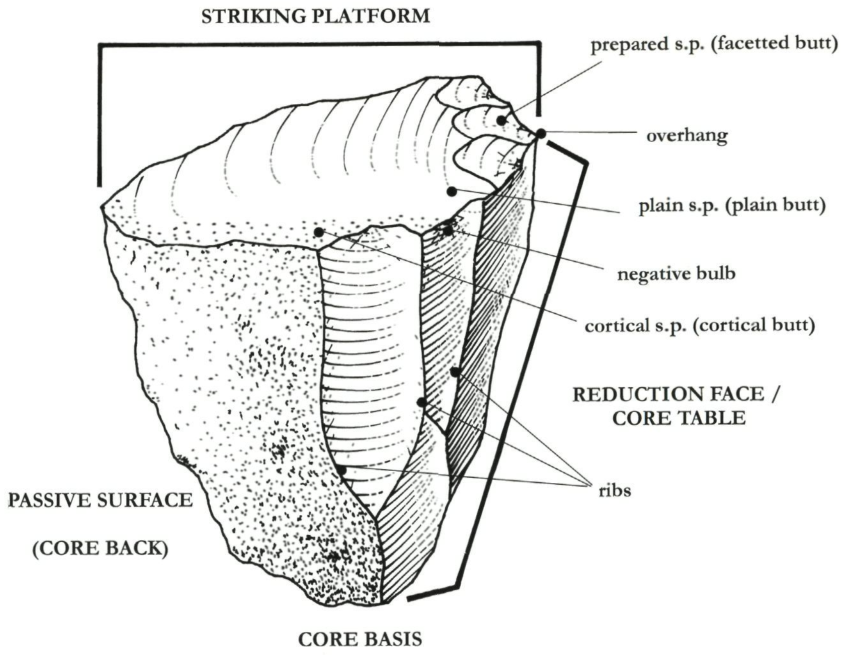
refit(ment): conjunction of at least 2 elements.

refitted set: conjunction of a few artefacts (in our study not more than five).

refitted co-set: whole of conjoining artefacts, substantially enough to reveal significant characteristics of the reduction strategy applied. Throughout our study we used this term somewhat arbitrarily to denominate any conjunction of more than five artefacts. All co-sets are systematically described in section 4.4.

refitting type: type of conjunction referring to the process that caused the severance: debitage (dorso-ventral refit, refit in reduction sequence), tooling (modification refit), fracturing or crumbling (break refits).

25 *Some descriptive terms for cores (after Inizan, Roche & Tixier 1992).*



Reduction/knapping

reduction sequence: the succession of manual actions performed in the course of reducing a volume of raw material up to the abandonment of the residual volume.

reduction sub-sequence: part of the reduction sequence consisting in a technologically coherent stage. Various reduction sub-sequences are: roughing out, platform rejuvenation, crest preparation, laminar reduction, ...

primary trimming (shaping out; core preparation): first stages of the reduction sequence, preparing the core for the '*plein débitage*'. For blade production, this generally includes the roughing out and the initial shaping of the core, the installation of a striking platform(s), and crest preparation.

roughing out (scabbling): rough preliminary operation in which the knapper removes major irregularities from the piece of stone *(Fr. dégrossissage)*.

decortication: stage of cortex removal, mostly as a result of roughing out of the core (the single intention to remove cortex seems almost non-existent at Rekem).

platform preparation: installation or rejuvenation of a striking platform, by facetting or by removal of a tabular flake.

platform abrasion: removal of the overhang on the intersection of the striking platform and the core table; this is a necessary technical procedure when blows are given close to the platform edge.

crest preparation (cresting): installation or rejuvenation of a crest.

laminar reduction: manufacture of blades and elongated flakes in a serial process. A laminar reduction may be subdivided into different *series*, interrupted by platform alternation, and different *generations*, separated by crest preparation or platform rejuvenation. A laminar reduction may be frontal (exploiting only the front of the core), semi-peripheral (generating a core table that includes most of the flanks) or peripheral (flanks and back involved).

(laminar) series: (part of a) laminar reduction characterised by a stable orientation (no change of platform).

(laminar) generation: continuous laminar production, not interrupted by any rejuvenation.

modification: secondary treatment of a blank: retouching, burin spall removal, intentional fracturing, etc.

Products

core: ultimate remaining volume after reduction.

blank: all (substantial) products that were intentionally removed from the core during the reduction sequence.

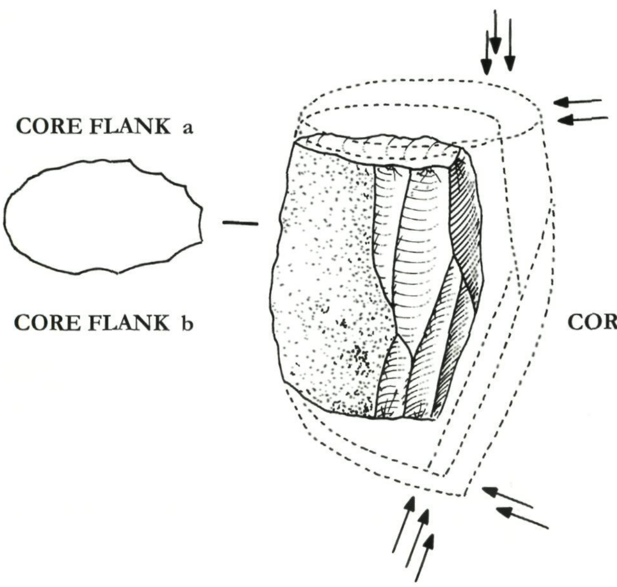
tabular flake: blank obtained during the renewal of a striking platform, reducing the length (height) of the core; from a morphological perspective, the edges of a tabular flake carry proximal negatives of former detachments.

core tablet: tabular flake that removed the entire striking platform.

crested blade: blade produced along a crest, generally triangular in cross-section, and often destined to initiate a laminar reduction. Crested blades may be partial (if the crest is determining a part of the dorsal face), primary or secondary, uni- or bidirectional.

blade: blank of which the following features are characteristic: length (at least) doubles width, reduced thickness, edges and scars are (sub-) parallel.

26 *Reduction sequence operating from two opposite platforms; with repeated platform renewal.*



bladelet: blade with reduced dimensions (conventionally with a width < 12mm, but this may vary in different industries).
laminar flake: elongated flake that meets one or several, but not all the characteristics of a blade.
support: blank that has been selected for modification.

Aspects
negative removal (scar): negative found on the core or on the dorsal face of a blank, as a result of previous knapping.
rib (arris): line formed by the meeting of two negative removals.
ridge: sharp "natural crest", formed by the intersection of two plane surfaces (which may be natural or artefactual). In the descriptions of the refitted co-sets, successively exploited ridges are codified with Arabic figures ('1', '2', '3', etc.).
butt: facet on a blank that received the blow of the hammer when it was detached from the core; at Rekem we essentially distinguish cortical, plain, dihedral, facetted, and rectilinear butt types.
crest: ridge with at least one modified face, often used to guide the first removal of a reduction (sub)-sequence.
striking platform: surface on the core which receives the blows of the hammer during the reduction of the core table. In the descriptions of the refitted co-sets, platforms are codified with capital letters ('A', 'B', 'C', etc.).
first striking platform: by convention the "upper face" of the core; "first" in a temporal sense.
core basis: "under face" of the core, opposed to the (first) striking platform.
core table: cf. reduction surface
reduction surface (core table, flaking face, debitage surface, etc.): "front face" of the core, systematically consumed during the reduction sub-sequences, wearing the scars of the production. In the descriptions of the refitted co-sets, core tables are codified with Roman numerals ('I', 'II', 'III', etc.).
passive surface (core back): surface that is not being exploited at the time of the observation (generally opposite to the reduction surface).
core flank: "lateral face" of the core, *i.e.* the face(s) alongside the core table. In the descriptions of the refitted co-sets, core flanks are codified with lower-case letters ('a', 'b', 'c', etc.)

4.2 Flint types

4.2.1 Introduction

Settling on the left bank of the river Meuse, the inhabitants of Late Glacial Rekem had direct access to the flint-bearing gravels of the riverbed and terraces. The flint types of these gravels, generally of Maastrichtian geological origin[6], are of inconstant quality, but certainly include appropriate raw materials for knapping purposes. Practically all flint varieties found at the site are indeed present in these localities, as was shown in a survey undertaken by the authors in 1991. Tertiary quartzite generally referred to as Wommersom quartzite, or lydite (in French known as *phtanite*, a variety of black chert from Ottignies/Céroux-Mousty in Belgium), is completely lacking at Rekem[7].

The vast majority of the flint artefacts can be grouped into two major raw material categories, *i.e.* fine grained, so-called Hesbaye flint (category 1), and coarse-grained flint (category 2). The distinction between these two groups is quite explicit. However, they are by no means homogenous groups. A range of texture, colour, and cortex variations can be observed, and were extremely useful in the refitting exercises. This variation also permitted the determination of numerous more narrowly defined flint types, based on the macroscopically observed characteristics of grain, colour, cortex, and occasional presence of fossils or other inclusions. It should be noted that this impressionistic classification equally relies on the extensive experience with this type of raw material by one of the authors, who for many years conducted fieldwork and surveys in the area[8].

Except for the category '0' (*i.e.* specification of flint type impossible, mostly due to thermic alteration), and for the restrained categories '3', '4', and '5' (see descriptions below), flint types have been defined for every locus separately. Within each locus

6 Caspar 1984.
7 We believe, in fact, that although phtanite was present in a *Federmesser* site at Ottignies (Soetens 1964; Caspar 1982; Caspar & Cahen 1982), neither tertiary quartzite nor phtanite had been intentionally targeted for exploitation by the *Federmesser* groups. It cannot be ruled out that the scarce presence of Wommersom quartzite and phtanite at Meer (Van Noten 1978) should be ascribed to an admixture of Mesolithic artefacts.
8 Caspar 1984.

of habitation zone 1, the categories 1 (fine-grained) and 2 (coarse-grained) were further subdivided in respectively types 11, 12, 13, etc. and in types 21, 22, 23, etc. The types 10 and 20 have been retained for the fine- and coarse-grained items without further specification, *i.e.* generally for poorly characterised miscellaneous groups of non-refitted artefacts, or limited reduction sequences which could not be attributed to any one of the specific types described in detail. Sometimes, these groups are very heterogeneous, whereas in other loci, they possibly incorporate items of a single reduction (*e.g.* type 20 at Rekem 10). In yet other cases (*e.g.* type 10 at Rekem 16), their number is too few to establish their specific characteristics.

Given the large amount of flint material, including many small items, which can in any case not be classified with certainty, only cores, tools, and refitted blanks have so far been ascribed to a specific flint type. On the other hand, the refits precisely sustain our conviction that many of the flint types described below actually assemble the products of a single reduction. Still, so long as artefacts are not refitted into one sequence, they cannot be associated with absolute certainty, *i.e.* one cannot fully exclude their belonging to different nodules of an identical flint type.

The spatial output of our classification proves that the (time-consuming) work of flint type specification at Rekem, was surely valuable, and indeed extremely useful as a starting point in the identification of spatial patterns (chapter 6). That was in fact the main goal of this exercise. Therefore, it should be stressed that this classification was essentially devised for the purposes of intra-site analysis. Any use beyond this scope should be treated with extreme caution.

Below is a macroscopic description of the various flint types, and the number of cores and tools associated with each of the specific flint types, as well as a list of (co-)sets with the number of refitted artefacts (counted before refitting of broken pieces).

4.2.2 Refined flint catalogue

4.2.2.1 General flint types

0. Altered to too great a degree to allow specification.
1. Fine-grained flint traditionally called 'Hesbaye Flint'.
2. Coarse-grained flint.
3. Matt fine-grained dark grey flint with numerous light, coarse-grained dots; 4 laterally modified laminar pieces (LMP), 2 burins, 3 scrapers, 2 truncated tools, 1 bec, 1 reamer, 1 composite tool, and 7 refitting artefacts in sets 05s074 & 12s01.
4. Translucent (glassy), very homogeneous dark brown fine-grained flint, with a white-yellow chalk cortex; 2 cores, 9 LMP, 4 burins, and 7 refitting artefacts in sets 05s089, 06s49 & 06s56.
5. Fine-grained opalescent flint; 1 scraper.

4.2.2.2 Specific flint types by locus

In the following list, the figure before the slash (/) refers to the locus number. For the figures after the slash: numbers starting with 1 are always fine-grained ('Hesbaye') flint; numbers starting with 2 are medium or coarse-grained flint, generally grey (ranging from light to dark); both numbers are in turn followed by consecutive numbering by flint type.

In some cases, a flint type of a certain locus perfectly matches with a flint type of one or several other loci. While these similarities are mentioned in the description of the flint types, the reference numbers are maintained by locus.

Rekem 1

1/21. Light grey coarse-grained flint with irregularly-shaped medium grey spots and a darker sub-cortical band of 0.5mm to 3mm thick, sometimes including a series of light ribbons; with a millimetre-thick (up to 6mm) yellow-beige chalk cortex (same as flint type 5/216, 7/22 and 12/22); 2 cores, 3 burins, 1 composite tool, and 62 refitting artefacts in (co)-sets 01c01, 01c02, 01s10, 01s20, 01s36, 01s40, 01s41 & 01s43.

1/22. Grey-beige to brownish coarse-grained flint, with lighter spots, bordered by a darker or whitish beige margin and with some chalky inclusions; the cortex is completely weathered; 1 core, 1 burin, and 24 refitting artefacts in (co)-sets 01c11, 01s19, 01s23 & 01s26.

1/23. Light grey, rather homogeneous coarse-grained flint, darker in the cortical zone; with a greyish-beige cortex; 1 burin, and 7 refitting artefacts in sets 01s01 & 01s27.

1/24. Medium grey coarse-grained flint, occasionally with a brownish reflection, traversed by a large beige-coloured belt (about 1cm wide); also with numerous silica-rich darker spots which occur either dispersed or densely concentrated, as well as with coarse beige discolorations of variable dimensions, but mostly < 1cm diameter; with a millimetre-thick beige cortex; 2 burins, 1 randomly retouched tool, and 15 refitting artefacts in (co)-sets 01c03, 01s14, 01s25, 01s34 & 01s39.

1/25. Light to medium grey rather homogeneous coarse-grained flint containing large compact clusters of numerous small circular or elongated stains; the cortex is eroded, but the outer surface equally presents patinated fracture facets; 1 core, 8 LMP, 2 truncated tools, and 14 refitting artefacts in (co)-sets 01c05 & 01s50.

1/26. Grey to greyish-beige coarse-grained flint with a rather irregular surface and a thin eroded cortex; a yellow band of up to 1cm thick is visible below the cortex (so-called Valkenburg flint); 7 refitting artefacts in co-set 01c12.

1/27. Light to medium grey very homogeneous coarse-grained flint with some small intensely silicified darker stains; with a thin beige cortex; 2 cores, 1 scraper, 3 truncated tools, and 19 refitting artefacts in sets 01s13, 01s18, 01s30, 01s32, 01s35 & 01s42.

1/28. Medium to dark grey coarse-grained flint with some coarse inclusions; the outer surface either displays a millimetre-thin eroded beige cortex, or glossy natural fractures; 1 core, 1 truncated tool, and 11 refitting artefacts in co-set 01c10.
1/29. Greyish-beige to orange-brown medium-grained flint with some bright irregular inclusions; locally traversed by thin reddish-brown lines; the cortex is completely eroded (same as flint type 15/24); 1 LMP, and 27 refitting artefacts in (co)-sets 01c04, 01s03, 01s04 & 01s05.

Rekem 4
4/21. Light to medium grey coarse-grained flint with lighter or darker elongated zones and small coarse inclusions; with a thin whitish-beige cortex; 1 core, and 19 refitting artefacts in (co)-sets 04c02 & 04s01.
4/22. Very dark, almost black, rather homogeneous coarse-grained flint with some lighter coarse inclusions of about 1cm diameter; with a whitish-beige millimetre-size cortex; 1 LMP, and 10 refitting artefacts in sets 04s04, 04s05 & 04s06.

Rekem 5
5/11. Translucent, medium to dark grey fine-grained flint, slightly brownish, speckled with chalky inclusions of variable density and mostly of millimetre size; the yellow/beige cortex is heavily rounded by intense river transport (same as flint type 6/11); 2 cores, 6 LMP, 11 burins, 15 scrapers, 1 bec, 2 randomly retouched tools, and 95 refitting artefacts in (co)-sets 05c13, 05c18, 05c19, 05s023, 05s024, 05s025, 05s026, 05s039, 05s045, 05s046, 05s063, 05s075, 05s078, 05s083, 05s085, 05s088, 05s091, 05s092, 05s105, 05s108, 05s111, 05s112, 05s113, 05s114, 05s115, 05s116, 05s118, 05s119 & 05s121.
5/12. Translucent, light grey fine-grained flint, marked with irregularly-shaped yellow-beige poorly silicified patches; none of the artefacts of this sample has cortex; 1 core, and 19 refitting artefacts in (co)-sets 05c23, 05s018, 05s022 & 05s034.
5/19. Light grey to beige, rather homogeneous fine-grained flint, with coarser whitish areas, and an orange patinated ancient fracture as exterior surface; 7 LMP of which 2 are refitted in set 05s106.
5/21. Grey coarse-grained flint with numerous small, dark grey, fine-grained patches; occasionally there are less-silicified zones of variable form and dimensions; the cortex, up to 3mm thick in certain areas, is smooth; non-cortical natural surfaces were also observed; 2 cores, 6 burins, 19 scrapers, 1 truncated tool, 1 borer, 1 bec, and 91 refitting artefacts in (co)-sets 05c01, 05c08, 05c10, 05c14, 05s015, 05s047, 05s061, 05s066, 05s080, 05s086 & 05s094.
5/22. Dark grey coarse-grained flint, with small diffusely contoured light grey speckles, with brown zones, and with less-silicified whitish-grey inclusions (same as flint type 10/26); 3 scrapers, 1 randomly retouched tool, and 5 refitting artefacts in set 05s095.
5/23. Grey coarse-grained flint with brownish reflections and with coarse light-beige maculae; 1 core, 8 burins, 1 scraper, 1 composite tool, 1 randomly retouched tool, and 45 refitting artefacts in (co)-sets 05c05, 05s014, 05s067 & 05s099.
5/24. Light to medium grey coarse-grained flint, rather homogeneous, with fine darker parallel stripes under the cortex; the latter is beige and very thin, or absent on certain reddish-brown residual 'natural' surfaces; 1 LMP, 17 burins, 1 truncated tool, 1 randomly retouched tool, and 96 refitting artefacts in (co)-sets 05c03, 05s077, 05s079, 05s082 & 05s110.
5/25. Light to medium grey coarse-grained flint, waxy in appearance, and spotted by numerous large coarse inclusions; 3 LMP, 12 burins, 3 truncated tools, 1 borer, 3 randomly retouched tools, and 31 refitting artefacts in (co)-sets 05c12, 05s064, 05s065, 05s068, 05s081, 05s084, 05s093 & 05s107.
5/26. Medium grey, rather homogeneous coarse-grained flint, with a darker millimetre-size band underneath the thin beige cortex; 3 burins, and 11 refitting artefacts in (co)-sets 05c22 & 05s062.
5/27. Matt greyish-beige medium-grained flint, with rather large, coarse inclusions. The yellow-beige cortex is weathered and partly characterised by small concavities; 3 cores and 37 refitting artefacts in (co)-sets 05c20, 05c21, 05s005, 05s006, 05s029 & 05s040.
5/28. Coarse-grained medium to dark grey flint, waxy in appearance and with occasionally very dense areas of millimetre-size, more or less regular black spots, and larger coarse stains. The cortex is rounded and almost completely dissolved at certain areas; 3 cores and 42 refitting artefacts in (co)-sets 05c07, 05s027 & 05s028.
5/29. Medium to dark grey coarse-grained flint, with numerous speckles and some large coarse light inclusions, as well as some rare very small black stains; with a thin beige cortex of 1mm to 2mm thick; 2 burins, 1 randomly retouched tool, and 18 refitting artefacts in co-set 05c04.
5/210. Coarse-grained, grey-beige, rather homogeneous flint, with some small to medium-sized rough beige inclusions. The cortex is weathered. At certain areas, a bundle of darker, intensely silicified parallel stripes can be observed, somewhat like pencil lines, which are maximum 2cm to 3cm long; there are also a few darker (sub-)circular stains of about 1mm ∅; 1 truncated tool and 42 refitting artefacts in (co)-sets 05c06, 05c11, 05s031 & 05s100.
5/211. Homogeneous coarse-grained grey-brown flint with greyish-beige speckled bands; with a whitish-beige cortex of 0.5mm to 5mm thick; 14 refitting artefacts in co-set 05c15.
5/212. Coarse-grained homogeneous light-grey flint with dark-grey to black, more or less regular spots of 1mm to 5mm ∅, as well as with lighter rather large coarse stains; the outer surface displays a weathered residual cortex, and glossy areas with a weak whitish-grey patination; 2 cores, 8 LMP, 1 truncated tool, and 59 refitting artefacts in (co)-sets 05c09, 05c17, 05c24, 05s001, 05s002, 05s010, 05s019, 05s036, 05s037, 05s059 & 05s104.
5/213. Medium-grey coarse-grained flint, rather heterogeneous because of the presence of very large rough inclusions; the cortex is heavily eroded; 2 cores,

and 19 refitting artefacts in (co)-sets 05c02 & 05s050.
5/214. Medium-grained very homogeneous light to medium grey flint, with light grey bands of 3mm to 8mm thick beneath the completely eroded cortex; there are some very rare coarse inclusions of medium size; 1 core, and 29 refitting artefacts in (co)-sets 05c16, 05s008, 05s012, 05s030, 05s033 & 05s058.
5/215. Coarse-grained rather homogeneous medium to dark grey flint, with more heterogeneous areas of coarse stains and small darker spots; occasionally, these stains and spots appear to be grouped in separate areas; 1 core, and 13 refitting artefacts in sets 05s016, 05s017, 05s020, 05s041 & 05s087.
5/216. Light grey coarse-grained flint with irregular-shaped medium grey spots and a darker sub-cortical band of 0.5mm to 3mm thick, sometimes including a series of light ribbons; with a millimetre-thick (up to 6mm) yellow-beige chalk cortex (same as flint type 1/21, 7/22, and 12/22); 1 core, and 2 refitting artefacts in set 05s038.

Rekem 6
6/11. Translucent, medium to dark grey fine-grained flint, slightly brownish, speckled with chalky inclusions of variable density and mostly of millimetre size; the yellow/beige cortex is heavily rounded by intensive river transport (same as flint type 5/11); 2 cores, 1 LMP, 1 burin, 1 scraper, and 12 refitting artefacts in sets 06s32, 06s34, 06s36, 06s50 & 06s58.
6/12. Medium to dark grey fine-grained flint with numerous light speckles and larger whitish-grey areas; the beige cortex is rough and about 1mm thick; 1 core, 1 randomly retouched tool, and 8 refitting artefacts in co-set 06c01.
6/21. Dark brown, homogeneous, coarse-grained flint with a thick beige cortex; 2 burins, and 4 refitting artefacts in sets 06s26 & 06s35.
6/22. Dark grey to black, coarse-grained flint with numerous speckles and with many stains in the central parts of the nodule; rather homogeneous just below the yellow-brown, millimetre-size, and completely weathered cortex; 1 core, 2 burins, 1 truncated tool, 12 refitting artefacts in (co)-sets 06c04, 06s42 & 06s63.
6/23. Fairly homogeneous medium grey to dark grey coarse-grained flint with some very coarse beige inclusions of 1cm ∅ maximum; the cortex is eroded; 1 core, and 16 refitting artefacts in sets 06s10, 06s17, 06s18, 06s19, 06s21, 06s25 & 06s41.
6/24. Medium to dark grey coarse-grained flint with some speckles and numerous spicula. The orange-coloured millimetre-size cortex is completely eroded; 1 core, and 14 refitting artefacts in (co)-sets 06c02 & 06s15.
6/25. Slightly translucent, greyish-beige medium-grained flint, with occasionally a coarse light beige inclusion; with an eroded cortex; 1 core, and 4 refitting artefacts in sets 06s28 & 06s29.
6/26. Medium to dark grey rather homogeneous coarse-grained flint, presenting two gelifractured surfaces with a bluish patination; 1 core, 1 randomly retouched tool, and 7 refitting artefacts in sets 06s01 & 06s24.

Rekem 7
7/21. Medium grained brownish-grey flint, with small light dots, and with a pale-brown zone beneath the thin chalk cortex; 1 core, 14 LMP, 4 burins, 2 scrapers, 2 truncated tools, and 30 refitting artefacts in (co)-sets 07c06, 07c08, 07c09, 07s12, 07s13, 07s29, 07s34, 07s36 & 07s37.
7/22. Light grey coarse-grained flint with irregularly-shaped, medium grey spots, and a darker sub-cortical band of 0.5mm to 3mm thick, sometimes including a series of light ribbons; with a millimetre-thick (up to 6mm) yellow-beige chalk cortex (same as flint type 1/21, and 5/216); 3 cores, 4 LMP, 1 scraper, 1 truncated tool, and 26 refitting artefacts in (co)-sets 07c05, 07s01, 07s02, 07s07, 07s09, 07s21, 07s27 & 07s31.
7/23. Medium grey, rather homogeneous coarse-grained flint, with a low number of rough stains and many small, more solidified speckles; the cortex is darker, rough and partly millimetre-thick; 23 refitting artefacts in (co)-sets 07c02, 07c03, 07s11, 07s16. (The flint type of these artefacts, as well as the debitage 'style', aiming at a production of large blanks are equally found in co-sets at Rekem 11 – type 11/22 – and Rekem 13 – type 13/21. None of these co-sets found at Rekem 7, Rekem 11, and Rekem 13 includes a core, nor do they refit with each other).

Rekem 10
10/11. Medium grey fine-grained flint with a yellow appearance, with numerous light speckles and rather coarse stains; the beige cortex is thin and not chalky; 2 cores, 3 LMP, 5 burins, 1 truncated tool, 2 composite tools, 1 randomly retouched tool, and 38 refitting artefacts in sets 10s01, 10s02, 10s10, 10s17, 10s18, 10s19, 10s20, 10s26, 10s28, 10s32, 10s34, 10s45, 10s56, 10s58 & 10s60.
10/12. Light grey, rather homogeneous fine-grained flint; 1 reamer.
10/14. Dark grey mat fine-grained flint with numerous large light grey irregular stains and some smaller darker speckles; 1 truncated tool.
10/19. Mat, medium grey, weakly banded; just 1 burin.
10/21. Medium grey coarse-grained flint with numerous brighter speckles. (This flint type has no other parallels at Rekem 10, where flint type 10/20 is almost ubiquitous); 3 burins, and 2 refitting artefacts in set 10s52.
10/22. Medium to dark grey medium-grained flint with rather large coarse inclusions; the beige cortex is very thin to millimetre-thick; 1 core, and 30 refitting artefacts in co-set 10c01.
10/23. Light to medium grey rather homogeneous medium-grained flint, waxy in appearance, traversed by sub-parallel strings; with a thin beige cortex of 0.5 to 1mm thick; 30 refitting artefacts in (co-)sets 10c03, 10s09, 10s14, 10s15, 10s27 & 10s43.
10/24. Light grey to beige coarse-grained flint with some very coarse inclusions; with a weathered cortex opposed to a weakly patinated natural shiny surface; 2 cores, and 11 refitting artefacts in co-set 10c06.

10/25. Light grey homogeneous coarse-grained flint with dark parallel bands and an eroded cortex; 1 scraper.
10/26. Dark grey coarse-grained flint, with small diffusely contoured light grey speckles, with brown zones, and with less silicified whitish-grey inclusions (same flint type as 5/22); 1 scraper.

Rekem 11
11/11. Medium to dark grey fine-grained flint with some large coarse stains with a light beige margin; the cortex is thin; 1 core, 2 burins, 1 truncated tool, and 6 refitting artefacts in sets 11s15, 11s16 & 11s23.
11/21. Coarse-grained grey-beige flint, waxy in appearance, with more or less extended speckles and stains; with a beige cortex; 2 LMP, 2 burins, and 7 refitting artefacts in (co)-sets 11s06, 11s08 & 11s09.
11/22. Medium grey, rather homogeneous coarse-grained flint, with a low number of coarse stains and many small, more solidified speckles; the cortex is darker, rough and partly millimetre-thick (same flint type as 7/23 and 13/21); 3 burins, and 11 refitting artefacts in (co)-sets 11c05 & 11s18.
11/23. Light grey, rather irregular coarse-grained flint, with coarse beige inclusions, sometimes of a large size (about 5cm diameter); medium to dark grey towards the exterior; with a beige cortex or with a weakly patinated bold exterior; 4 cores, 7 LMP, 2 burins, 2 scrapers, 2 truncated tools, and 24 refitting artefacts in (co)-sets 11c01, 11c02 & 11s24.
11/24. Medium grey, rather homogeneous coarse-grained flint, with sparse small darker stains with a weathered cortex; 2 cores, 1 burin, and 14 refitting artefacts in co-set 11c04.
11/25. Medium to dark grey medium-grained flint, abundantly speckled, and with a completely eroded shiny outer surface, with an orange-brown patination (same as flint type 12/25); 1 core, 2 burins and 9 refitting artefacts in (co)-sets 11c07 & 11s19.
11/26. Light to medium grey coarse-grained flint; fossiliferous; with a thin beige cortex (< 1mm); 1 core, and 6 refitting artefacts in sets 11s03 & 11s04.
11/27. Dark grey abundantly speckled coarse-grained flint, similar to 11/25, but with a millimetre-thick beige cortex; 1 core, and 10 refitting artefacts in (co)-sets 11c03, 11s07 & 11s11
11/28. Dark grey coarse-grained flint with many spicula; 1 randomly retouched tool.

Rekem 12
12/11. Medium grey fine-grained flint, with a thin whitish-beige cortex, accentuated below the outer surface by a thin dark reddish-brown margin; 2 cores, 3 burins, 3 scrapers, and 28 refitting artefacts in (co)-sets 12c04, 12c05, 12s02, 12s05, 12s31 & 12s39.
12/12. Medium grey fine-grained flint with numerous irregularities, with a thin whitish-beige cortex, accentuated below the outer surface by a thin dark reddish-brown margin; 1 burin, 2 scrapers, and 7 refitting artefacts in sets 12s06, 12s13 & 12s34.
12/21. Generally light grey, rather heterogeneous coarse-grained flint, waxy in appearance, with sometimes very large coarse stains and numerous small fine-grained dark irregular speckles; with a beige cortex; 1 core, 1 LMP, 4 burins, and 60 refitting artefacts in (co)-sets 12c01, 12s03, 12s08, 12s12, 12s16, 12s18, 12s32, 12s35, 12s37, 12s38 & 12s42.
12/22. Light grey coarse-grained flint with irregularly-shaped medium grey spots and a darker sub-cortical band of 0.5mm to 3mm thick, sometimes including a series of light ribbons; with a millimetre-thick (up to 6mm) yellow-beige chalk cortex (same as flint types 1/21, 5/216, and 7/22); 1 core, and 8 refitting artefacts in co-set 12c03.
12/23. Dark grey to black coarse-grained flint with numerous speckles, but rather homogeneous below the yellow-brown, completely weathered cortex of millimetre-size; 2 scrapers, and 7 refitting artefacts in sets 12s10, 12s29 & 12s30.
12/24. Medium to dark grey coarse-grained flint, rather homogeneous, with small black stains and larger centimetre-size coarse inclusions, beige with a grey-coloured centre. The beige chalk cortex is about 1mm thick; 7 scrapers, and 12 refitting artefacts in sets 12s04, 12s14, 12s15 & 12s28.
12/25. Medium to dark grey medium-grained flint, abundantly speckled, and with a completely eroded shiny outer surface with an orange-brown patination (same as flint type 11/25); 2 scrapers.

Rekem 13
13/21. Medium grey, rather homogeneous coarse-grained flint, with a few rough stains and many small, more solidified speckles; the cortex is darker, rough and in places millimetre-thick (same as flint types 7/23 and 11/22); 1 core, 1 randomly retouched tool, and 55 refitting artefacts in (co)-sets 13c01, 13c02, 13s01, 13s02, 13s03, 13s04, 13s05 & 13s06.

Rekem 15
15/11. Light grey fine-grained flint with white dots and with a slightly weathered chalk cortex; only unrefitted debitage waste (used in spatial analysis of Rekem 15).
15/21. Light grey coarse-grained flint with very coarse inclusions and with a slightly weathered, irregular, rough cortex; 2 cores, 1 burin, and 30 refitting artefacts in (co)-sets 15c01, 15c02, 15c04, 15s06 & 15s07.
15/22. Medium grey coarse-grained flint with a fresh chalk cortex; 2 cores, 1 burin, and 16 refitting artefacts in (co)-sets 15c03, 15c06 & 15s03.
15/23. Greyish-brown coarse-grained flint with pale grey dots and with a battered chalk cortex; 1 core, and 11 refitting artefacts in (co)-sets 15c05, 15s04 & 15s05.
15/24. Greyish-beige to orange-brown medium-grained flint with some bright irregular inclusions; locally traversed by thin reddish-brown lines; the cortex is completely eroded (same as flint type 1/29); 6 refitting artefacts in sets 15s01 & 15s02.

Rekem 16
16/21. Light grey coarse-grained flint, darker grey towards the cortex, with frequent coarse stains of variable dimensions, and small more condensed silica-

rich zones; with a beige millimetre-thick cortex; 1 core, 5 burins, and 73 refitting artefacts in (co)-sets 16c03, 16c04, 16s01, 16s02, 16s03, 16s05, 16s10, 16s12, 16s13, 16s14, 16s16 & 16s25.
16/22. Light to medium grey rather homogeneous, medium-grained flint, with slightly darker areas; with an eroded cortex; 1 core, and 18 refitting artefacts in co-set 16c02.
16/23. Grey-beige mat homogeneous coarse-grained flint, traversed by – occasionally extended – light brown areas, and bordered by a fine dark edge; 2 cores, 1 scraper, 1 randomly retouched tool, and 5 refitting artefacts in set 16s24.
16/24. Brown-beige mat medium-grained flint with speckles and some small coarse stains; with an eroded cortex; 3 scrapers, and 7 refitting artefacts in sets 16s18, 16s19 & 16s26.
16/25. Light to medium-grey very homogeneous coarse-grained flint; with a thin eroded cortex; 1 core, 1 reamer, and 29 refitting artefacts in co-set 16c05.
16/29. Beige-coloured, homogeneous coarse-grained flint, with some very coarse inclusions. It has a beige-whitish cortex and an old fracture face with a yellowish patination (so-called Valkenburg-type flint); 27 refitting artefacts in co-set 16c01.

4.3 General inventory of cores, core rejuvenation, and debitage products

In its present state, the Rekem *Federmesser* assemblage totals 83.5 kg of flint, divided into 23,496 artefacts at 14 different loci[9]. Detailed inventories of numbers, weight, and average weight of the various artefact categories by locus are provided in Tables 13-15.

More than half of these artefacts are 'chips', *i.e.* flakes less than 20mm long. These tiny elements do not provide extensive technological information, and they have not (yet) been involved in the refitting process. Their informative potential lies mainly in spatial analysis.

All other artefacts, *i.e.* 9,005 flakes and blade(let)s, 356 core rejuvenation products, and especially the 215 cores, are presented in further detail below. The retouched tools (N=977), edge-damaged pieces (N= 302), and waste products of tooling (N=402) are discussed in chapter 5. In all, the data-set of habitation zone 1 which was intensively studied during the refitting work, consisted of some 10,800 items. At the time of writing, 2,311 of these (21.4%) could effectively be included in one of the 521 refitting groups which together constitute the large three-dimensional 'puzzle' which we were able to reconstruct from the Rekem flints. These refits are presented in detail in section 4.4.2.

4.3.1 Debitage products: blade(let)s and flakes

In all, 6,111 flakes and broken flakes, and 2,894 blades, bladelets, and broken blade(let)s, *i.e.* a total of 9,005 unmodified blanks > 20mm have been recorded at Rekem. A selected sample of some of the larger items is illustrated on Pl. 8: 1-12.

At first sight, the assemblage seems to be characterised by a high blade(let) index (*i.e.* 32%, or about one third of the blanks), but this observation should be put into perspective. Firstly, a majority (58%) of the blade(let)s comprise fragments. When only complete blanks are considered, the blade(let) index falls to 22%. Secondly, we have applied the label 'blade-(let)' to every removal whose length is at least equal to twice its width and which has *more or less* parallel edges. Other criteria (limited thickness, parallel negative removals) have been adopted in a very unrestrained way. In other words, although well-shaped blades exist (*e.g.* Pl. 8: 5, 10), most of these elements are not extremely regular long 'elegant' blade(let)s, but chiefly short, poorly standardised items, often with cortex or randomly organised negative removals on their dorsal face. In fact, the terms 'laminar flake' or 'elongated flake' would better suit many of these specimens. Unfortunately, we only introduced this notion during the refitting analysis, as it could be shown that 'laminar flakes' are in fact the most 'characteristic' blanks of this assemblage, and would appear to be the intended products. The distinction between 'blade' and 'laminar flake' has not (yet) been made for non-refitted blanks, *i.e.* the category 'laminar flake' is not included in the general inventory.

Likewise, in the same inventory, no distinction is made between blades and bladelets. Since the systematic recording of blank dimensions is part of a running project (see above), the data for a possible statistical distinction of dimensional groups are not yet available. However, it would surprise us to find such pertinent groupings of blank size, as the refitting analysis will demonstrate that single reduction sequences generally produced a continuum of large to small laminar elements (section 4.5).

Clearly, an even broader range of dimensions would be expected for the flakes. The specimens in this group are mostly complete items (72%). There is no systematic patterning regarding the organisation of the dorsal negative removals on the flakes. However, some also have parallel scars and ribs, and were classified here only because they were (slightly) shorter than twice their width (often because of hinging). In the refitting analysis, such elements will also be classified with the laminar flakes.

An interesting point is raised when one compares the presence of cortex on the various blank categories. In all, about one third of the complete blanks are covered with cortex on at least one third of their dorsal face (fragments are not considered here, because the degree of cortex on the 'lost' part is evi-

9 Rekem 3, which was heavily disturbed, and the partially excavated assemblage of Rekem 9 are not yet included in these totals.

Table 13

Rekem 1984-86. General inventory of flint artefacts at the various loci.
*Rekem 3 (heavily disturbed) and Rekem 9 (partially excavated) are not included in this list.
**only burin spalls and Krukowski microburins; other tool waste material is not (yet) systematically distinguished from 'chips'.

	Locus*															
Artefact list	1	2	4	5	6	7	8	10	11	12	13	14	15	16	Total	%
Cores																
Prismatic cores	10	6	2	13	17	9	-	2	7	6	3	5	1	4	85	0.4%
Pyramidal cores	6	1	2	9	10	2	-	1	1	4	-	-	2	-	38	0.2%
Globular (polyhedral) cores	4	-	-	-	5	-	-	2	2	1	-	2	1	-	17	0.1%
Flat and irregular cores	6	2	3	2	6	1	-	3	5	2	-	2	1	2	35	0.1%
Broken cores	6	2	-	3	3		-	4	1	1	1	1	-	4	26	0.1%
Tested blocks	-	1	2	1	2	1	-	2	-	2	-	2	-	1	14	0.1%
Subtotal	*32*	*12*	*9*	*28*	*43*	*13*	*0*	*14*	*16*	*16*	*4*	*12*	*5*	*11*	*215*	*0.9%*
Core rejuvenation products																
Crested blade(let)s	43	2	-	55	36	20	-	27	18	20	4	9	3	4	241	1.0%
Tabular flakes	7	1	4	5	8	2	-	6	6	12	2	4	-	2	59	0.3%
Core sides	12	-	-	6	7	1	-	6	3	8	-	-	2	11	56	0.2%
Subtotal	*62*	*3*	*4*	*66*	*51*	*23*	*0*	*39*	*27*	*40*	*6*	*13*	*5*	*17*	*356*	*1.5%*
Debitage products																
Flakes	528	38	38	818	443	202	6	235	162	249	28	159	34	89	3029	12.9%
Broken flakes	308	26	20	474	231	82	1	154	149	127	12	27	19	62	1692	7.2%
Cortical flakes	218	11	33	349	225	94	2	64	53	185	8	48	29	71	1390	5.9%
Blade(let)s	119	26	23	212	132	52	1	70	41	69	9	22	2	19	797	3.4%
Broken blade(let)s	216	25	27	418	275	86	-	309	82	137	21	39	1	47	1683	7.2%
Cortical blade(let)s	17	9	22	103	93	19	-	35	27	47	3	15	6	18	414	1.8%
Chips	2973	46	25	2626	925	1293	-	682	1573	1109	118	298	77	398	12143	51.7%
Subtotal chips included	*4379*	*181*	*188*	*5000*	*2324*	*1828*	*10*	*1549*	*2087*	*1923*	*199*	*608*	*168*	*704*	*21148*	*90.0%*
Subtotal chips not included	*1406*	*135*	*163*	*2374*	*1399*	*535*	*10*	*867*	*514*	*814*	*81*	*310*	*91*	*306*	*9005*	*38.3%*
Debris (lumps)	11	1	3	35	15	2	-	3	2	4	-	3	-	17	96	0.4%
Retouched tools	113	14	11	281	179	55	4	122	62	71	2	32	2	29	977	4.2%
Edge-damaged pieces	35	2	-	107	36	12	4	30	18	38	4	-	-	16	302	1.3%
Tool waste products**	35	4	1	145	65	18	-	45	45	32	1	-	1	10	402	1.7%
Total	*4667*	*217*	*216*	*5662*	*2713*	*1951*	*18*	*1802*	*2257*	*2124*	*216*	*668*	*181*	*804*	*23496*	100.0%
%	20%	1%	1%	24%	12%	8%	0%	8%	10%	9%	1%	3%	1%	3%	100%	

dently unknown). Interestingly, blades and flakes share similar ratios in this respect: 34% of the blades and 31% of the flakes are cortical. This equality suggests that the initial stages of core preparation generated both flakes and blades, in similar proportions as during the later sequences of the reduction. Apparently, nodules at Rekem were directly exploited by a (laminar) reduction whenever possible. The fact that cortical pieces were also frequently selected for tooling (see below), equally indicates that the presence of cortex was not an essential issue for the prehistoric artisans.

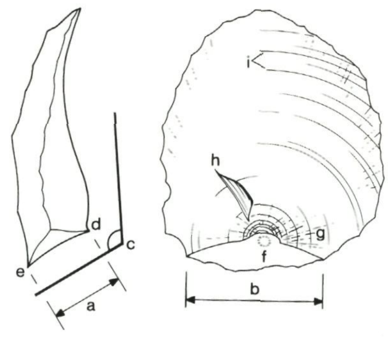
Finally, flakes with a maximum diameter smaller than 20mm are counted as chips. The chips are not further subdivided in the inventory tables, but the counting of samples indicates that in terms of overall dimensions, about 25% of them have a maximum diameter of between 20mm and 15mm, about 40% of between 15mm and 10mm, and some 35% are smaller than 10mm. Items smaller than 5mm diameter are rare[10]. For the moment, there has been no systematic classification of the chips which were produced as a by-product of debitage knapping on the one hand, and retouch flakes, *i.e.* waste products of tooling, on the other (except for burin spalls and Krukowski microburins).

The technological features of blade(let)s and flakes, including overall dimensions, dimensions and types of butts, descriptions of bulbs of percussion, percussion ripples, blade profiles, overhang preparation, flaking angles, etc. are presently being examined as part of a larger project (Caspar & De Bie, research in progress) and will not be considered in great detail here. However, the recording of technical attributes on a small sample of the debitage products from Rekem 6 and Rekem 10, which were analysed as part

[10] During excavation, a 4mm grid was used to sieve the exhumed sand. At several loci, the sand was also sampled to screen it for micro-chips (flint-dust) in the lab. A preliminary inspection shows that micro-chips are indeed quite abundant in the dense (presumed) debitage areas, but at the time of writing, the sand samples have not yet been subjected to further analysis.

of a diachronic comparative study[11], allows for a general preliminary appreciation of the technical and qualitative aspects of the debitage products. The identification of most of the attributes is illustrated in fig. 27.

A large majority of both the blade(let)s and flakes in the random sample carry a plain (or flat) butt. Other butts, *i.e.* cortical, dihedral, facetted or linear types, do also occur, but they are far less common. Spurs (*'talon en éperon'*) are completely lacking. In fact, there are no specific butt types for blades: facetted and dihedral examples also occur on flakes. This comparability is somewhat opposed to the observations made with regard to the platform preparation on the various core types, where an overrepresentation of facetted platforms is noticed on laminar cores (section 4.3.3). This 'contradiction' may partly result from the fact that butt dimensions on flakes are on average twice as large as they are on blades. The likelihood that a detaching blank includes one or several ribs of the core striking platform on its butt, is therefore smaller for blades than for flakes, given a similar type of platform.



27 *Some of the attributes taken into consideration in the analysis of flakes and blades:*
a) butt thickness;
b) butt width;
c) flaking angle;
d) butt lip;
e) overhang;
f) impact point;
g) bulb striae;
h) bulb scar;
i) percussion ripples.

[11] De Bie 1999.

Table 14

Rekem 1984-86. General weight distribution of flint artefacts at the various loci (in g).
*Rekem 3 (heavily disturbed) and Rekem 9 (partially excavated) are not included in this list.
**only burin spalls and Krukowski microburins; other tool waste material is not (yet) systematically inventoried.

	Locus*															
Artefact list	1	2	4	5	6	7	8	10	11	12	13	14	15	16	Total	%
Cores																
Prismatic cores	724	539	111	1288	1463	605	-	80	784	349	144	916	503	334	7840	9.4%
Pyramidal cores	141	40	63	499	885	72	-	33	48	158	-	-	263	-	2202	2.6%
Globular (polyhedral) cores	545	-	-	-	558	-	-	164	258	291	-	361	68	-	2245	2.7%
Flat and irregular cores	621	291	261	190	563	78	-	196	714	637	-	434	236	62	4283	5.1%
Broken cores	537	113	-	119	84	-	-	86	48	81	116	21	-	266	1471	1.8%
Tested blocks	-	580	342	92	140	185	-	481	0	422	-	2392	-	794	5428	6.5%
Subtotal	*2568*	*1563*	*777*	*2188*	*3693*	*940*	*0*	*1040*	*1852*	*1938*	*260*	*4124*	*1070*	*1456*	*23469*	*28.1%*
Core rejuvenation products																
Crested blade(let)s	264	13	-	503	254	160	-	151	116	211	28	50	33	126	1909	2.3%
Tabular flakes	139	44	43	31	145	13	-	54	37	475	8	92	-	20	1101	1.3%
Core sides	234	-	-	40	246	6	-	45	86	288	-	-	147	599	1691	2.0%
Subtotal	*637*	*57*	*43*	*574*	*645*	*179*	*0*	*250*	*239*	*974*	*36*	*142*	*180*	*745*	*4701*	*5.6%*
Debitage products																
Flakes	1748	233	204	2047	2112	857	9	828	640	1279	127	1187	137	322	11730	14.0%
Broken flakes	773	45	79	1570	523	127	2	228	323	328	18	53	73	123	4265	5.1%
Cortical flakes	1493	78	424	2601	2193	1170	11	396	633	1629	54	452	398	557	12089	14.5%
Blade(let)s	445	210	95	894	380	202	3	320	170	354	46	111	10	90	3330	4.0%
Broken blade(let)s	499	79	55	848	361	143	-	563	172	346	91	57	3	191	3408	4.1%
Cortical blade(let)s	143	87	140	588	583	135	-	211	98	415	12	137	76	191	2816	3.4%
Chips	485	14	5	482	186	185	-	126	181	269	36	81	21	73	2144	2.6%
Subtotal chips included	*5586*	*746*	*1002*	*9030*	*6338*	*2819*	*25*	*2672*	*2217*	*4620*	*384*	*2078*	*718*	*1547*	*39782*	*47.6%*
Subtotal chips not included	*5101*	*732*	*997*	*8548*	*6152*	*2634*	*25*	*2546*	*2036*	*4351*	*348*	*1997*	*697*	*1474*	*37638*	*45.1%*
Debris (lumps)	357	74	167	1391	572	91	-	54	68	110	-	70	-	1793	4747	5.7%
Retouched tools	765	193	94	1555	1181	279	50	522	373	344	40	202	15	266	5879	7.0%
Edge-damaged pieces	643	24	-	1624	543	201	58	383	221	551	65	-	-	309	4622	5.5%
Tool waste products**	36	1	1	82	35	22	-	32	41	28	2	-	0	21	301	0.4%
Total	10592	2658	2084	16444	13007	4531	133	4953	5011	8565	787	6616	1983	6137	83501	100.0%
%	13%	3%	2%	20%	16%	5%	0%	6%	6%	10%	1%	8%	2%	7%	100%	

Percussion marks (impact points of the hammer) on the butts are absent in the majority of cases. On about one third of the butts, however, they are vaguely present, and sometimes clearly marked. Examples of detached butts are also present. Distinctions between flakes and blades are minimal, suggesting that hammer types were not fundamentally different for the production of either type of blank. Further analysis on this topic is certainly required.

Overhangs on the Rekem blades repeatedly protrude substantially. The slight abrasion of these overhangs and thinning (*amincissement*) by means of tiny removals both occur, but most *corniches* on the blades were apparently unmodified. Again, in this respect, flakes and blades were not treated differently. It should also be mentioned that the preparation of the overhang is seemingly largely dependent on the width of the flaking angle. In cases where angles are 90°-100° wide, they were rarely prepared, while most overhangs are modified if the flaking angles attain more than 120°. This differentiation is probably governed by a purely technical reason, since the preparation on an *angle de chasse* of 90° would make it obtuse and generally render a detachment impossible.

Flaking angles[12] on blades also do not differ significantly from those on flakes. At Rekem 6 most blades have a more or less right flaking angle measuring just over 90°. Rekem 10 has medium angles of about 100°. Flaking angles on flakes appeared to be very similar, with averages between 90° and 100°. There are no examples of canted butts.

With regard to the ventral face of the blanks, it may be noted that *Federmesser* blades almost exclusively carry large percussion ripples. On the flakes, the predominance of large undulations is even more manifest. In the light of discussions on the importance of the type of undulations, it should be remarked that raw materials clearly have a certain influence here: tiny contracted ripples could be found on fine-grained flint types, but seldom on coarse-grained variants.

[12] In measuring the flaking angle, the proximal half of the ventral face was used, ignoring the curvature of the bulb. Using intervals of 10°, subsequent checks proved these measurements more reliable than first expected.

Table 15

Rekem 1984-86. Mean weight of the various artefacts types by locus (in g).
*Rekem 3 (heavily disturbed) and Rekem 9 (partially excavated) are not included in this list.
**only burin spalls and Krukowski microburins; other tool waste material is not (yet) systematically inventoried.

	Locus*														
Artefact list	1	2	4	5	6	7	8	10	11	12	13	14	15	16	Total
Cores															
Prismatic cores	72.4	89.8	55.5	99.1	86.1	67.2	-	40.0	112.0	58.2	48.0	183.2	503.0	83.5	92.2
Pyramidal cores	23.5	40.0	31.5	55.4	88.5	36.0	-	33.0	48.0	39.5	-	-	131.5	-	57.9
Globular (polyhedral) cores	136.3	-	-	-	111.6	-	-	82.0	129.0	291.0	-	180.5	68.0	-	132.1
Flat and irregular cores	103.5	145.5	87.0	95.0	93.8	78.0	-	65.3	142.8	318.5	-	217.0	236.0	31.0	122.4
Broken cores	89.5	56.5	-	39.7	28.0	-	-	21.5	48.0	81.0	116.0	21.0	-	66.5	56.6
Tested blocks	-	580.0	171.0	92.0	70.0	185.0	-	240.5	-	211.0	-	1196.0	-	794.0	387.7
Subtotal	*80.3*	*130.3*	*86.3*	*78.1*	*85.9*	*72.3*	*0.0*	*74.3*	*115.8*	*121.1*	*65.0*	*343.7*	*214.0*	*132.4*	*109.2*
Core rejuvenation products															
Crested blade(let)s	6.1	6.5	-	9.1	7.1	8.0	-	5.6	6.4	10.6	7.0	5.6	11.0	31.5	7.9
Tabular flakes	19.9	44.0	10.8	6.2	18.1	6.5	-	9.0	6.2	39.6	4.0	23.0	-	10.0	18.7
Core sides	19.5	-	-	6.7	35.1	6.0	-	7.5	28.7	36.0	-	-	73.5	54.5	30.2
Subtotal	*10.3*	*19.0*	*10.8*	*8.7*	*12.6*	*7.8*	*0.0*	*6.4*	*8.9*	*24.4*	*6.0*	*10.9*	*36.0*	*43.8*	*13.2*
Debitage products															
Flakes	3.3	6.1	5.4	2.5	4.8	4.2	1.5	3.5	4.0	5.1	4.5	7.5	4.0	3.6	3.9
Broken flakes	2.5	1.7	4.0	3.3	2.3	1.5	2.0	1.5	2.2	2.6	1.5	2.0	3.8	2.0	2.5
Cortical flakes	6.8	7.1	12.8	7.5	9.7	12.4	5.5	6.2	11.9	8.8	6.8	9.4	13.7	7.8	8.7
Blade(let)s	3.7	8.1	4.1	4.2	2.9	3.9	3.0	4.6	4.1	5.1	5.1	5.0	5.0	4.7	4.2
Broken blade(let)s	2.3	3.2	2.0	2.0	1.3	1.7	-	1.8	2.1	2.5	4.3	1.5	3.0	4.1	2.0
Cortical blade(let)s	8.4	9.7	6.4	5.7	6.3	7.1	-	6.0	3.6	8.8	4.0	9.1	12.7	10.6	6.8
Chips	0.2	0.3	0.2	0.2	0.2	0.1	-	0.2	0.1	0.2	0.3	0.3	0.3	0.2	0.2
Subtotal chips included	*1.3*	*4.1*	*5.3*	*1.8*	*2.7*	*1.5*	*2.5*	*1.7*	*1.1*	*2.4*	*1.9*	*3.4*	*4.3*	*2.2*	*1.9*
Subtotal chips not included	*3.6*	*5.4*	*6.1*	*3.6*	*4.4*	*4.9*	*2.5*	*2.9*	*4.0*	*5.3*	*4.3*	*6.4*	*7.7*	*4.8*	*4.2*
Debris (lumps)	32.5	74.0	55.7	39.7	38.1	45.5	-	18.0	34.0	27.5	-	23.3	-	105.5	49.4
Retouched tools	6.8	13.8	8.5	5.5	6.6	5.1	12.5	4.3	6.0	4.8	20.0	6.3	7.5	9.2	6.0
Edge-damaged pieces	18.4	12.0	-	15.2	15.1	16.8	14.5	12.8	12.3	14.5	16.3	-	-	19.3	15.3
Tool waste products**	1.0	0.3	1.0	0.6	0.5	1.2	-	0.7	0.9	0.9	2.0	-	0.0	2.1	0.7
Total	2.3	12.2	9.6	2.9	4.8	2.3	7.4	2.7	2.2	4.0	3.6	9.9	11.0	7.6	3.6

The bulbs of percussion on the blades are often slightly marked, but pronounced salient bulbs also occur. In profile, the blades and bladelets are more often curved than straight. Bulbs on flakes are clearly more substantial. Bulb scars are present on about one third of the blades, and half of the flakes. In both cases, they can either be oriented obliquely or follow the debitage direction. Finally, bulb striae are also clearly present on both blades and flakes and repeatedly occur on both sides of the bulb (so-called '*moustaches*'[13]).

Taken together, these features seem to indicate that, for both flake and blade debitage, the flint knapping at Rekem was largely dominated by the use of direct hard hammer percussion throughout the reduction process. On the other hand, the inter-unit variability (between Rekem 6 and Rekem 10) also argues for 'style' differences, possibly induced by a difference in individual or collective knapping skills.

4.3.2 Core rejuvenation products

The 356 recognised core rejuvenation products have been classified as crested pieces, tabular flakes, and core sides (Table 13). Given the 'flexible' reduction methods characterising this *Federmesser* industry (see below), the distinction between these categories is not always clear-cut. It should be emphasised that these 'technological' categories were essentially defined on purely morphological grounds, and do not necessarily correspond to their actual technical roles in the reduction sequence.

4.3.2.1 Crested pieces

There are a total of 241 crested pieces from the various loci. Although most of the complete specimens have laminar dimensions (length is at least equal to twice the width), they hardly qualify as well-elaborated crested blades (Pl. 9: 1-2). There are in fact no signs of standardisation. Many of the pieces are also broken. The vast majority of these artefacts have been prepared on a single versant only (unidirectional crests) and in a rather rudimentary style. The number of removal negatives is generally small, and the area where they occur on the dorsal face is often restrained. On other occasions, the crest preparation hardly seems to have modified the original shape of a 'natural' ridge.

4.3.2.2 Tabular flakes

Tabular flakes are here defined as flakes with edges that are at least partly constituted by (proximal parts of) negative marks left by former perpendicular removals. As the refitting has shown, there is no perfect match between these morphologically defined specimens and flakes which have actually resulted from platform renewal.

Table 16
Rekem 1984-86. Flint types of cores at the various loci.
0. Undetermined (patinated or heavily burnt) flint.
1. Fine-grained 'Hesbaye' flint.
2. Coarse-grained flint.
4. Translucent fine-grained brown flint.
See section 4.2.2.2 for description of specific flint types by locus.

	Locus														
Flint type	1	2	4	5	6	7	10	11	12	13	14	15	16	Total	%
0	-	-	-	1	-	-	-	-	-	-	-	-	-	1	0%
10	1	1	1	2	6	3	-	-	1	-	-	-	1		
11	-	-	-	2	2	-	2	1	2	-	-	-	-		
12	-	-	-	1	1	-	-	-	-	-	-	-	-		
Subtotal 1	1	1	1	5	9	3	2	1	3	0	0	0	1	27	13%
20	20	11	7	6	28	6	9	6	10	3	12	-	5		
21	2	-	1	2	-	1	-	-	1	1	-	2	1		
22	1	-	-	-	1	3	1	-	1	-	-	2	1		
23	-	-	-	1	1	-	-	4	-	-	-	1	2		
24	-	-	-	-	1	-	2	2	-	-	-	-	-		
25	1	-	-	-	1	-	-	1	-	-	-	-	1		
26	-	-	-	-	1	-	-	1	-	-	-	-	-		
27	2	-	-	3	-	-	-	1	-	-	-	-	-		
28	1	-	-	3	-	-	-	-	-	-	-	-	-		
29	4	-	-	-	-	-	-	-	-	-	-	-	-		
212	-	-	-	2	-	-	-	-	-	-	-	-	-		
213	-	-	-	2	-	-	-	-	-	-	-	-	-		
214	-	-	-	1	-	-	-	-	-	-	-	-	-		
215	-	-	-	1	-	-	-	-	-	-	-	-	-		
216	-	-	-	1	-	-	-	-	-	-	-	-	-		
Subtotal 2	31	11	8	22	33	10	12	15	12	4	12	5	10	185	86%
4	-	-	-	-	1	-	-	-	1	-	-	-	-	2	1%
Total	32	12	9	28	43	13	14	16	16	4	12	5	11	215	100%

This divergence is partly confirmed by the limited number of tabular flakes identified at Rekem. In proportion to some 200 cores, totalling considerably more striking platforms, only 59 tabular flakes have been counted. This is a small number indeed, as the refitting indicated that the reduction sequences at Rekem generally embraced multiple platform renewal episodes.

Most of the tabular flakes seem to have removed only part of the core's striking platform. Real core tablets, *i.e.* pieces detaching the whole platform, are rare.

4.3.2.3 Core sides

In all, 56 rejuvenation elements have been listed as core sides ('*flanc de nucleus*'), *i.e.* pieces which have removed all or a large part of the core's reduction face. Many of these specimens probably result from the fact that re-orientation of the flaking direction was occasionally employed as a rejuvenation technique. The sides of the cores then served as a striking platform from which to exploit the former core table in a crossing direction.

[13] cf. Tixier 1982, 15.

Table 17
Rekem 1984-86. Cores: morphology, platform number, and knapping direction.
(tested blocks and most broken cores are not included).

Number and disposition of striking platforms, and direction of knapping on reduction face		Morphology (shape) of core							
		Prismatic	Pyramidal	Globular	Flat	Irregular	Broken	Total	%
Single platform,	unipolar knapping	21	21	5	10	6	3	66	36%
	bipolar knapping	2	5	-	1	-	1	9	5%
Two opposite platforms,	unipolar knapping	2	-	2	-	2	-	6	3%
	bipolar knapping	60	12	2	3	6	2	85	47%
Two crossed platforms,	unipolar knapping	-	-	-	-	2	-	2	1%
	multidirect. knapping	-	-	-	1	1	-	2	1%
Multiple platforms,	multidirect. knapping	-	-	8	-	3	-	11	6%
Total		85	38	17	15	20	6	181	100%
%		47%	21%	9%	8%	11%	3%	100%	

4.3.3 Cores

All 215 cores and core fragments from the site have been analysed in detail. An inventory of attributes is provided in annex, with references to the plates for illustrated specimens (Pl. 10-20).

A great majority of the cores (86%) are in coarse-grained flint; 2 specimens are of flint type 4, and 1 core was too heavily burnt for an adequate flint type specification. 74 of the 188 cores[14] (39%) could be ascribed to a more specific flint type, *i.e.* 12 fine-grained specimens and 62 of the coarse-grained variants (Table 16).

Included in this inventory of 215 cores are also the so-called tested blocks, *i.e.* cobbles with one or a few negative removals only (N=14; 7%), as well as substantial core fragments (N=26; 12%; Table 13). As these categories are only partially informative with regard to debitage characteristics, they were largely excluded from the discussion. The exceptions to this are a few substantial core fragments which seemed still to be representative of the complete cores. In all, 181 elements were subjected to a more detailed techno-morphological analysis, presented below, which should provide a preliminary general idea of the flint technology. One of the additional objectives of the following 'static' examination is to test this picture subsequently with the insights obtained from a dynamic analysis of the refitted reduction sequences, presented in section 4.5.

The degree of standardisation in the core assemblage is rather poor. In terms of overall morphology, almost half of the 181 specimens have a more or less prismatic shape (N=85; 47%). About one fifth are pyramidal cores (N=38; 21%); 17 (9%) are multifacetted globular cores, as opposed to 15 (8%) rather flat volumes, that sometimes seem to have departed from very large flakes (Pl. 11: 4); finally, the shape of 20 cores (11%) could only be qualified as 'irregular'. In the latter case, the ultimate shape of the cores was mostly still essentially determined by the natural morphology of the flint nodule.

From another point of view, the assemblage can be divided into single platform cores (N=75; 41%), two platform cores (N=95; 52%) – almost exclusively opposed platforms (N=91) –, and multiplatform cores (N=11; 6%). Whereas this classification is of course related to the former one (*i.e.* prismatic cores generally have two opposed platforms, pyramidal cores mostly have one, etc) it is worth stipulating that these characteristics are not mutually interchangeable (Table 17). In fact, more than a quarter (N=23) of the prismatic cores have a single platform, while almost one third (N=12) of the pyramidal cores show remnants of a (small) second platform opposed to the principal striking surface. Globular cores are frequently multiplatform types (N=8), but some also have a single platform (N=5) or two opposed platforms (N=4).

Moreover, it appears from the direction of the negative removals on the reduction faces that the number and disposition of the platforms are not necessarily accurate indications of the knapping direction(s) (Table 17). Core tables on 6 opposed platform cores (7%) carry scars that were provoked from one knapping direction only, while 9 single platform cores (12%) have the remains of bi-directional scars. The backs of the cores were in fact sporadically used as opposite striking surfaces (naviform shapes). Therefore, with just 36% of the cores combining a single platform with unidirectional negative removals on the reduction face, and taking into account that a final plunging flake on some of these may have removed evidence of a bipolar reduction method, it seems that the debitage at Rekem was mainly organised from (at least) two opposed striking platforms. The analysis of the refits below will largely confirm this observation and repeatedly reveals that the number of knapping directions throughout a reduction was even considerably greater.

Just over half of the cores have either 'natural' (*i.e.* were not modified before exploitation; N=17 or 9%) or 'plain' platforms (*i.e.* created by a single core tablet removal; N=73 or 40%), or a combination of

[14] Not including the burnt element, the 2 cores of flint type 4, and the cores of Rekem 2 and Rekem 14; the latter, outside habitation zone 1, have not yet been subjected to a detailed flint type analysis.

Table 18
Rekem 1984-86. Cores: state of striking platforms by shape.
(tested blocks and most broken cores are not included).

State of striking platform(s)	Morphology (shape) of core Prismatic	Pyramidal	Globular	Flat	Irregular	Broken	Total	%
Cortical/natural surface	6	1	1	3	5	1	17	9%
Plain	32	19	8	4	6	4	73	40%
Faceted	37	17	6	8	9	1	78	43%
Cortical + plain	4	1	1	-	-	-	6	3%
Cortical + faceted	3	-	-	-	-	-	3	2%
Plain + faceted	3	-	-	-	-	-	3	2%
Undetermined	-	-	1	-	-	-	1	1%
Total	85	38	17	15	20	6	181	100%

both (N=6 or 3%; Table 18). Platforms on the other cores are at least partly facetted, *i.e.* they carry negatives from several (small) overlapping removals (N=84 or 46%). It should be stipulated that these are generally not very regular, small parallel negative removals which served to preform individual butts of future blanks. Rather, the platforms were facetted by flakes of various sizes, struck from various directions, and often having hinging terminations (Pl. 10: 1,5; Pl. 11: 1; Pl. 12: 4,5; Pl. 13: 1; Pl. 14: 1; Pl. 15: 1,4; Pl. 16: 5; Pl. 17: 2; etc.). Their only apparent purpose was to adjust the flaking angle. Occasionally, repeated attempts at platform renewal also created crushed platform edges (Pl. 20: 1). Generally, the angle between the (principal) striking platform and the core table (*'angle de chasse'*), measured near the centre of the reduction face, fluctuates around 80°.

No immediate correlation could be detected between the methods of platform preparation and the overall morphologies of the cores (Table 18). On the other hand, it seems that facetted striking platforms occur more frequently on cores with two opposed platforms (50 of 91 = 55%) than on single platform cores (29 of 75 = 39%; Table 19). This tendency is not contradicted when compared with the direction of production (unipolar or bipolar), as observed on the reduction faces. Tentatively, this might indicate that changes of platform in the course of the reduction sequence instigated platform facetting. Conversely, whenever a platform appeared to be suitable as a striking surface, the knapper preferred to continue to use it without further rejuvenation.

Apart from these observations, the platform preparation methods are also correlated with the type of production observable on the core tables (Table 20). Whereas blade[15] cores are mostly characterised by facetted platform(s) (47 of 77 = 61%), all other core types most frequently have natural or plain striking platforms. Whether they served for a production of bladelets, laminar flakes, or flakes, in each case just over one third of the cores are equipped with facetted platform(s). As reported earlier (section 4.3.1), such distinctions of core platform preparation between the various types of product is not reflected to the same degree on the butt types of flakes and blades. A possible explanation for this discrepancy has been given above (*i.e.* differences in butt size), but it should also be stipulated that the distinction between the various types of production, as observed on the reduction faces, is not always clear-cut. Bladelet cores often show the remnants of (former) blade production, core tables of blade cores frequently display the negative removals of laminar flakes or flakes, etc. This miscellaneous character of much of the debitage is further confirmed by the refitting evidence. Still, in overall terms, it seems that knapping was principally directed at the production of (short) blades (43% of the cores), or laminar flakes (33%), and less frequently at bladelets (14%) or flakes (10%).

As opposed to blade and laminar flake cores which mostly have a prismatic shape (also frequently irregular or globular in case of laminar flakes), almost half of the bladelet cores are pyramidal (Table 21). Interestingly, the reduction faces indicate that bladelets – like blades – were still mostly obtained by a bipolar production (for both groups in about two third of the cases; Table 22). Laminar flakes, by contrast, are more frequently associated with unipo-

15 Blades as read from the negative removals on the cores were generally not much above 12mm wide and never very long. Exceptionally, more sizeable blades seem to have been produced (cf. Pl. 13.1).

Table 19
Rekem 1984-86. Cores: state of striking platforms by platform number.
(tested blocks and most broken cores are not included).

State of striking platform(s)	Platform number Single	Two opposite	Two crossed	Multiple	Total
Cortical/natural surface	9	5	1	2	17
Plain	33	34	2	4	73
Faceted	27	46	1	4	78
Cortical + plain	4	2	-	-	6
Cortical + faceted	2	1	-	-	3
Plain + faceted	-	3	-	-	3
Undetermined	-	-	-	1	1
Total	75	91	4	11	181

Table 20
Rekem 1984-86. Cores: state of striking platforms by type of production.
(tested blocks and most broken cores are not included).

State of striking platform(s)	Type of production Blades	Bladelets	Lamin. flakes	Flakes	Undeterm.	Total
Cortical/natural surface	5	2	4	5	1	17
Plain	23	14	30	6	-	73
Faceted	44	9	20	5	-	78
Cortical + plain	2	-	4	-	-	6
Cortical + faceted	1	-	1	1	-	3
Plain + faceted	2	-	1	-	-	3
Undetermined	-	-	-	1	-	1
Total	77	25	60	18	1	181
%	43%	14%	33%	10%	1%	100%

Table 21
Rekem 1984-86. Cores: type of production on various shapes.
(tested blocks and most broken cores are not included).

Morphology (shape) of core	Type of production Blades	Bladelets	Lamin. flakes	Flakes	Undeterm.	Total
Prismatic	49	8	25	3	-	85
Pyramidal	14	12	11	1	-	38
Globular	-	1	8	8	-	17
Flat	8	2	4	1	-	15
Irregular	3	2	10	4	1	20
Broken	3	-	2	1	-	6
Total	77	25	60	18	1	181

Table 22
Rekem 1984-86. Cores: crosstable of type and direction of production as observed on the reduction faces. (Tested blocks and most broken cores are not included.)

Direction of production	Type of production Blades	Bladelets	Lamin. flakes	Flakes	Undeterm.	Total
Unipolar	26	9	31	8	-	74
Bipolar	51	16	25	1	1	94
Multipolar	-	-	4	9	-	13
Total	77	25	60	18	1	181

Table 23
Rekem 1984-86. Cores: extension of the reduction face(s) for various types of production. (Tested blocks and most broken cores are not included.)

Direction of production	Reduction face extension Front	Front+one side	Front+two sides	All round	Total
Unipolar	39	23	9	2	73
Bipolar	30	35	24	4	93
Multipolar	3	1	-	8	12
Total	72	59	33	14	178
%	40%	33%	19%	8%	100%

lar reduction faces (only 42% of these cores show a bipolar production). Finally, flakes were produced either by a unipolar reduction method or from multiple different directions.

When, for the sake of the description, cores are circumferentially partitioned into 4 equal parts, the extension of the reduction face is, in a decreasing number of cases, limited to one side (*i.e.* the core front; 40%), two sides (core front and one flank; 33%), three sides (core front and two flanks; 19%) or four sides (all round; 8%). In general, bipolar reduction faces occupy more of the core circumference than unipolar ones (Table 23). It is also interesting to note that the mean weight of the cores is inversely correlated with the number of sides that were occupied by the core table – with one notable exception: the cores that were exploited 'all round' are also the most heavy. Most of these are of the globular type (polyhedral), and seem to have been abandoned early because a lack of suitably sharp ridges impeded further reduction. Actually, there is a distinct group of globular cores with very similar dimensions (a cross-section of about 5cm; see also fig. 28).

When the back of a core is not consumed by the reduction face, or flaked at an earlier stage, it is mostly left cortical or 'natural'. Signs of intentional cresting at that side, *i.e.* maintenance of the core flank(s) proceeding from the back, are in fact quite rare (*e.g.* Pl. 15: 2; Pl. 16: 5). In all, about 35% of the cores have preserved indications of intentional shaping by lateral removals, generally restricted to one flank, and launched either from the front or from the back. They were observed more frequently on blade cores (38 of 75 = 51%) than on cores for bladelets (7 of 25 = 28%), laminar flakes (15 of 60 = 25%) or flakes (3 of 18 = 17%; Table 24). Together with the higher number of facetted platforms on blade cores (see above), this observation indicates that blade cores were indeed more profoundly prepared than cores that served for other types of production.

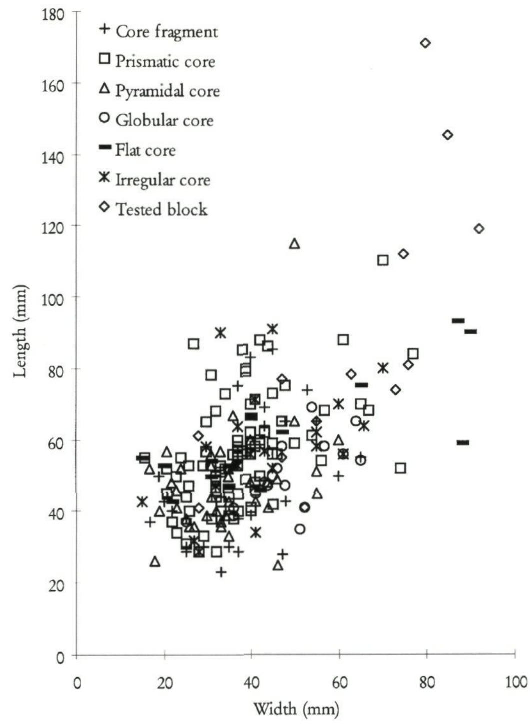
4.3.4 Interim conclusions and comparisons

The general inventory of the flint artefacts provides a provisional elementary account of the nature and style of the lithic technology at Rekem. In overall terms, the assemblage seems to be generated by a poorly elaborated laminar technology, lacking rigid preparation procedures and aiming at the production of short unstandardised blades and elongated flakes. Knapping appears to have been dominated by direct hard hammer percussion.

This general picture radically deviates from the 'classic' Upper Magdalenian blade technology as, for example, perceived at the nearby Magdalenian open air site of Kanne[16]. In the central sector of this site, the lithic industry reflects a high degree of standardisation in the manufacturing of blades. This was sustained by the autonomous and elaborate shaping out of the cores, including the arrangement of propitious vertical and horizontal curvatures of the core table (*carène* and *cintre*), as well as the installation of one or two autonomous striking platforms, in a sharp angle with the core table. The *plein débitage* at Kanne is characterised by a stable production of normalised blades, initiated along a frontal crest and travelling onto the flanks, and mostly struck from one preferred striking platform. The latter was rapidly renewed due to the frequent implementation of intensive butt facetting (*talons en eperon*) and overhang blunting. These procedures in turn are imposed by the use of direct soft hammer percussion. The convex shape of the core table throughout this process is maintained by lateral removals from the front (creating *néo-crêtes*), or the back of the core (creating a posterior crest).

Most of these characteristics are completely lacking at Rekem. In general terms, it is clear that the Late Palaeolithic lithic technology in this region is marked by a transition from elaborate pre-planned blade debitage involving standardised core preparations, to a technology with simplified laminar reduction processes, characterised by a lack of regulation. To

28 *Rekem 1984-86. Length-width distribution of cores by shape.*



our knowledge, 'intermediate' industries between Magdalenian and *Federmesser* knapping traditions, analogous to recently discovered 'Early' *Federmesser* assemblages in Northern France[17], have not yet been recognised in the Belgian lowlands.

Further comparisons, including other assemblages from NW Europe, will be drawn in the general conclusions of this chapter. First, we will now focus on the results of the refitting analysis and see how they contributed to a fine-tuning of our view on the lithic technology at Rekem.

Table 24
Rekem 1984-86. Cores: layout of core flanks for various types of production.
(Tested blocks and most broken cores are not included.)

	Type of production					
Core flank(s)	Blades	Bladelets	Lamin. flakes	Flakes	Undeterm.	Total
Cortical (or 'natural' surface)	15	7	24	9	-	55
Shaped intentionally (lateral removals)	9	4	5	2	-	20
Covered by reduction face or 'ancient' scars	16	9	12	6	1	44
Cortical + intentionally shaped	13	2	7	1	-	23
Cortical + reduction face or 'ancient' scars	6	2	9	-	-	17
Intentionally shaped + other scars	16	1	3	-	-	20
Total	75	25	60	18	1	179

16 Vermeersch *et al.* 1985.
17 Bodu 1995; Valentin 1995; Fagnart 1997.

4.4 Refitting

4.4.1 Methodology

Simply stated, the refitting of flint artefacts can be described as being exactly the reversal of the flint-knapper's craft. Instead of reducing a block of flint by detaching a series of blanks, the refitter starts with the blanks and tries to fit them back in the correct order of removal, thus reconstructing three-dimensional puzzles[18].

At Rekem, at the time of writing, this procedure resulted in 521 refitting groups, all assembled from habitation zone 1, and totalling 2311 artefacts. These entities have all been examined from a technical, economic and spatial point of view. In what follows, the dynamic development of the individual reduction sequences that include more than 5 artefacts (arbitrarily named co-sets; N=86), is systematically described. The characteristics of the less extensive refits are also shortly summarised, with an emphasis on particular technological observations. A general assessment is given by locus.

Particular attention is paid to the selection of the nodules and to the following phenomena: their state of introduction into the site; the aims of the reduction, the type and style of exploitation, and possible reasons for their abandonment; the production in terms of economical results (tools, used pieces, possibly export); the technical quality of the knapping sequence; and finally the spatial layout of the co-set. All of this, of course, is as it could be observed on the state of the refits to date. Occasionally, we also refer to other sequences that on the basis of raw material and type of debitage most likely belonged to the same original nodule.

4.4.1.1 Selected nodules

When feasible, we estimate the original dimensions of the volume, describe the morphology of the nodule, evaluate the flint quality, and refer to the flint types described in section 4.2.2. In case of very specific types of flint, various sets could occasionally be ascribed to one sequence. Although these associations certainly do not have the value of actually refitted artefacts, in several cases they did provide useful information.

4.4.1.2 Description of the reduction sequence

The *chaîne opératoire* has been considered in its dynamic development, from the primary shaping of the nodule to the abandonment of the (exhausted) core. Where possible, we tried to structure the reduction sequence into several sub-sequences, distinguishing stages of roughing out, platform preparation or rejuvenation, crest preparation, flake production, and laminar production (blades, bladelets or laminar flakes). Series were also considered to have come to an end whenever a change of platform occurred (cf. glossary of terms, section 4.1.2). Clearly the products obtained during these series are not strictly interdependent of them. For example, not all flakes of a platform preparation procedure necessarily correspond with morphologically defined tabular flakes. Secondly, a laminar reduction series did not exclusively generate blades (they were merely intended). Thirdly, flakes can be produced in all kinds of subsequences, etc.

Secondary modification (tooling) is also mentioned in this description, but this aspect gets more attention in the particular chapter on 'blank consumption' (chapter 5).

Finally, a special paragraph is devoted to an assessment of the possible reason(s) for the abandonment of the reduction sequence.

4.4.1.3 Productivity of the sequence (estimation of 'economic output')

The artefacts produced in each production sequence are classified in major categories (flakes, laminar flakes, blades, bladelets, cores). The category 'laminar flake', which was not employed in the original inventory of the debitage products, was added when it was realised that this is in fact the most adequate description for what may be considered the most 'characteristic' blank type of this *Federmesser* industry (*i.e.* elongated flakes with some, but not all, the characteristics of a blade). The real productivity of the sequence, in terms of serviceable output, is estimated by listing the refitted tools, 'adequate' blanks and, if such is the case, artefacts with traces of use-wear. Special attention is also paid to possible criteria employed in the selection of blanks for tooling.

4.4.1.4 Quality of knapping (technical level of the artisan)

In a concluding paragraph of the description, we also provide a general evaluation of the 'quality of knapping', as perceived in the refitted sequence. We make this evaluation with reference to the various quantitative and qualitative aspects of the reduction process such as raw material selection, the shaping out of the core, the general organisation and standardisation of the knapping process, the emergence of flaking accidents and possible corrections, the stage of core abandonment, the quantity, quality and size of the output, and so on.

Our initial goal in this assessment was to build a database that would allow us to distinguish a range of technical levels and possibly relate these with the knapping skills of individual artisans as, for example, demonstrated for Magdalenian assemblages of the Paris basin[19]. However, in the course of this exer-

[18] Cahen *et al.* 1980; Cziesla 1990a.
[19] cf. Pigeot 1987; Ploux 1989; Bodu 1993.

cise at Rekem, we realised that several criteria used in this assessment are in fact quite ambiguous[20]:

- the intensive preparation and rejuvenation of the striking platform, for instance, on the one hand could point at an advanced level of technical know-how while on the other hand, it could equally refer to a knapper who failed to execute an efficient, economic laminar production without constant renewal of the platform (and thus unfavourable reduction of the core table length).
- With regard to the quality of the raw material selection, it is obvious that poor selection does not necessarily have to be ascribed to inexperienced knappers. In fact, small, irregularly shaped stones could perhaps only be exploited by competent knappers, and only with a 'simple' reduction process.

Since such ambiguity can be revealed in many of the criteria used to establish the 'quality' of knapping, this aspect of the analysis should be treated with some caution. In the present state of research we merely intended to open the 'knapping skill debate' with regard to the *Federmesser* industries. More reflection and provisional conclusions on this topic are presented in section 4.6.2.

4.4.1.5 Spatial layout

Whereas the spatial dimension of our study has been essentially centralised in chapter 6, we thought it useful to present the distribution of the individual refitted co-sets at the end of each description. For certain aspects mentioned in those paragraphs (*e.g.* locations of hearths, dwellings, etc.), the reader may occasionally have to consult the pages on spatial analysis in chapter 6. A synthesis on the spatial output of knapping activities at the site as a whole is also presented there. The technical aspects of the graphic presentation of refits were presented in chapter 1.

4.4.2 Descriptive analysis of refitted co-sets

4.4.2.1 Rekem 1

Co-set 01c01 (Pl. 21; Map 28)

This co-set is built up of a total of 34 flakes, blades, tools and burin spalls. The cores are missing. Its flint type (1/21) is generally of good quality, although the original, extremely large nodule (diameter > 20cm) exploited for this sequence, contained some flaws which caused it to split into several parts. Reduction on three of these parts is documented here. Except for the long blade (or burin spall) that was transported to Rekem 7 (see below), all other elements of this sequence were abandoned in the dense flint scatter of Rekem 1.

Part A

The original volume of the first part may have been an extremely large flake. In that case, the present reconstruction represents a bipolar reduction of the distal end of that flake. In pure technological terms, this is in other words a burin spall removal episode rather than a core reduction process. The size of these hypothetical burin spalls is however completely divergent from the spalls generally produced at Rekem. The length of the largest one attains more than 12cm (for a max. width of 1.6cm). Interestingly, this element has been retrieved at Rekem 7, at a distance of about 20m from Rekem 1. In fact, Rekem 7 contains many other artefacts of the same flint type, named 7/22 in that locus.

A second large flake belonging to part A was also further modified into a burin (or reduced as a core?). One spall could be refitted to it.

Part B

Although this part is poorly documented (represented by just 4 removals, of which one is broken in 3 parts), it probably consisted of a rather extensive bipolar exploitation.

Part C

1. Refit state: As opposed to the other parts, this sequence is very well documented, despite the fact that the core is lacking.
2. Original nodule: Dim. min. 12.7 x 7.8 x 9.0cm.
3. Reduction sequence: The first removal of this sequence was guided by a ridge flanked by the very large negative removal of part A on one side, and a natural flaw of the original nodule on the other side. In turn, the negative of the first removal served as a core flank (a) throughout the further sequence. The other flank (b) was formed by an ancient flaw. After the detachment of 2 cortical flakes (one could be refitted), from one end of the block, a first generation of half a dozen (partly cortical) blades was initiated along the ridge of intersection of the cortical surface with flank (a). Three of the larger blades of this generation are refitted. The knapper then struck one (refitted) rejuvenation flake from platform (A) and continued the laminar series along core table (I), near flank (b). None of these removals travelled very far on the reduction face, however, and when they began to suffer from hinging terminations, platform (A) was again rejuvenated (the thick core tablet of this rejuvenation could be refitted). A new laminar generation was created along the same core table (I), producing at least 5 very nice blades (3 are refitted), but then removals started hinging again. The next platform rejuvenation was rather intense, generating a set of thick flakes. The last generation documented in this refitted co-set consisted of at least 7 regular blades (4 are refitted), the last one still 6.5cm long, all along the core table (I). Unfortunately, the rest of the sequence could not be refitted (yet).
4. Core/abandonment: Unknown dimensions, but compared with the original block, the size was reduced quite heavily.
5. Productivity: A very rich output of at least two dozen thin blades and elongated flakes. One of the core flank trimming products was modified into a

20 We thank in particular B. Valentin for drawing our attention on this enigma.

composite tool (burin/truncation; Pl. 104: 1; Pl. 105: 2). Part A also included one or two burins (Pl. 89: 1), although they might alternatively be interpreted as cores on flakes. None of the artefacts appeared to carry microscopic traces of use-wear.
6. Quality of knapping: Prosperous unidirectional laminar reduction sequence with appropriate shaping of the flanks and numerous platform rejuvenations (at least 4). Platform renewal mostly occurred when the laminar products of a generation started suffering from hinging.
7. Spatial layout: cf. above (all elements derive from the dense flint scatter of Rekem 1).

Co-set 01c02 (Pl. 22; Map 29)

1. Refit state: A series of 9 blanks.
2. Original nodule: Dim. unknown; coarse-grained good quality flint (type 1/21). May have belonged with 01c01.
3. Reduction sequence: All the artefacts of this sequence were detached from a single platform that was at least twice renewed. The first renewal could be reconstructed (2 flakes).
4. Core/abandonment: Unknown.
5. Productivity: A range of small laminar flakes and large trimming flakes. One of the former was transformed into a burin (Pl. 76: 6). None of the artefacts bears traces of usewear.
6. Quality of knapping: Consistent unidirectional laminar production.
7. Spatial layout: Distributed in the dense scatter of Rekem 1.

Co-set 01c03 (Pl. 22; Map 30)

1. Refit state: A conjoinment of 6 blanks, illustrating part of a reduction sequence.
2. Original nodule: Dim. unknown (min. length 9.2 cm); coarse-grained good quality flint (type 1/24).
3. Reduction sequence: This set represents a subsequence of unidirectional laminar reduction. Although there are clear traces of platform renewal and unifacial cresting, none of the preparatory flakes have been refitted, except for a large cortical flake that was seemingly detached during initial shaping of the nodule.
4. Core/abandonment: Unknown.
5. Productivity: A rich series of large blades. One of these has been modified into a burin on truncation (Pl. 76: 5). None of the artefacts bears traces of usewear.
6. Quality of knapping: Successful laminar production. Several butts were intentionally prepared (facetted).
7. Spatial layout: All elements, including the burin, were situated on the edges of the dense artefact cluster of Rekem 1.

Co-set 01c04 (Pl. 23; Map 31)

This co-set consists of 3 flat parts that originally belonged to a single slab (min. dim. 10.8 x 6.1 x 4.0cm) of medium grained flint (type 1/29) with a worn exterior surface and several internal frost fractures. The 18 reassembled artefacts provide a fairly complete illustration of these 3 parts, but at least two additional fragments are not (yet) conjoined. All elements were found mixed up in the dense scatter of Rekem 1.

Part A

1. Refit state: 10 blanks (fragments included) refitted on the core.
2. Original size: 5.5 x 1.5 x 5.6cm (*i.e.* a very flat slab).
3. Reduction sequence: The first removal (broken in 3 fragments) refitted on this part was probably detached from the complete original nodule and seemingly provoked its splitting up along the internal frost cracks. The knapper then started cresting the opposite edge of the slab, thus causing another breaking up, creating parts A and B. Next, two intensively prepared unifacial crests were successively removed along the opposite edge to initiate the core table (I). The laminar generation that followed was rather limited, however, and terminated when the final detachment plunged and destroyed the base of the core (partly along another frost fracture facet).
4. Core/abandonment: Dim. 5.5 x 1.6 x 3.6cm.
5. Productivity: A few bladelets at most. No usewear observed.
6. Quality of knapping: Difficult to judge from such a badly flawed nodule (which indicates that there was no severe selection procedure). The crests were skilfully shaped.

Part B

This part is only represented by the core, which had seemingly served for the making of generations of bladelets from two opposed platforms. Dim. 4.5 x 2.0 x 2.5cm.

Part C

1. Refit state: 6 blanks (fragments included) refitted on the core.
2. Original size: 7.8 x 2.2 x 5.2cm (*i.e.* a very flat slab).
3. Reduction sequence: The size of this slab was severely reduced by the first removals (4 flakes). Still, the knapper managed to produce a series of half a dozen blades from the small residual block. One of those has been refitted, indicating that the platform was rejuvenated (at least) once.
4. Core/abandonment: Dim. 5.5 x 1.6 x 3.6cm. The last detachments severely suffered from hinging.
5. Productivity: A few blades and bladelets; no usewear observed.
6. Quality of knapping: Again difficult to judge from this badly flawed block, but there was a certain know-how of blade(let) production.

Co-set 01c05 (Pl. 24; Map 32)

1. Refit state: This co-set of 10 blades and flakes (including fragments) refitted to the core provides accurate information on the reduction strategy applied.
2. Original nodule: Dim. min. 10.2 x 8.6 x 4.6cm; coarse-grained good quality flint (type 1/25), though occasionally with very rough inclusions. Probably a fist-size nodule.
3. Reduction sequence: Debitage on this nodule started with the installation of a striking platform (A) that was kept in use throughout the sequence, without further renewal. This procedure generated a few large flakes. The laminar series was initiated along the intersection of the cortical surface and an ancient fracture face. The first laminar generation produced 4 blanks. Three of those could be refitted; 2 were selected for LMP production. Before detaching a second generation of laminar products, the flank (a) of the core was reduced by the removal of a few large flakes. The first large blank of the second laminar series, a piece eventually exported to Rekem 16, was therefore crested on one side. The rest of the sequence gradually exploited the core table towards the opposite flank which was occasionally used for the detachment of transverse removals along the reduction face. A major part of the further sequence is missing, but it seems that the same strategy was adopted until the abandonment of the core. Only during the very final stage of reduction, was there an additional attempt to exploit the core basis as well.
4. Core/abandonment: 5.8 x 4.1 x 3.4cm. One negative removal shows traces of hinging.
5. Productivity: It can be estimated that the sequence generated between 10 and 20 laminar products, next to a range of trimming flakes. Two blades (the first removals) were selected for the production of laterally modified laminar pieces (Pl. 68: 26-27), but they both broke in the course of manufacture. The destination of this core for LMP production is also supported by the refitting of another 'failed' attempt of LMP manufacture and two truncated tools in set 01s50, which almost certainly belongs with this co-set. None of these products bear traces of use.
6. Quality of knapping: Although the volume was hardly brought into shape before initial reduction, the gain of laminar products was relatively prosperous. The striking platform was not renewed, but the reduction surface was occasionally subjected to unidirectional cresting. The overhangs of some blades reveal platform abrasion.
7. Spatial layout: Except for a large crested blade that was 'exported' to Rekem 16, all other elements are distributed in the dense scatter of Rekem 1.

Co-set 01c06 (Pl. 25; Map 33)

1. Refit state: A conjoinment of 3 large flakes and 5 laminar products to the core provides an accurate illustration of the reduction system.
2. Original nodule: Dim. min. 6.8 x 5.5 x 3.6cm (very minimal estimation); coarse-grained good quality flint (type 1/20). The original shape is unknown, but it contained at least one flat surface.
3. Reduction sequence: The original shaping of the block seems well-organised. It consists of the installation of two opposed platforms as well as of two (opposed) flanks. Some of the large flakes, which had been detached to create one of these flanks (a), could be refitted. The first (and single) reassembled laminar product struck from platform (A) suffered from hinging, and immediately led to the definite abandonment of that side of the core. All subsequent blades were struck from the opposite platform (B) along core table (I). The series was repeatedly interrupted for platform renewal (facetting), and once also for partial cresting along flank (a). The final removals gradually started plunging and eventually destroyed the residual core.
4. Core/abandonment: Dim. 3.6 x 2.7 x 2.0cm; small single platform core with a cortical back.
5. Productivity: A suite of small blades. The 'best' products are probably missing. No traces of use-wear observed.
6. Quality of knapping: Rather careful pre-forming of the volume, occasional cresting, and facetting of the blade butts, reveal a certain experience in flintknapping.
7. Spatial layout: All elements were closely clustered in the northern sector of the dense flint scatter.

Co-set 01c07 (Pl. 25; Map 34)

1. Refit state: 7 flakes and fragments conjoining with the core provide an accurate picture of the various reduction stages.
2. Original nodule: Dim. 6.9 x 8.5 x 8.4cm.; a polyhedral block of coarse-grained flint (type 1/20) which originally must have belonged to a larger unit (no cortical outer surface preserved).
3. Reduction sequence: The first removals from this block are very large thick flakes. They were detached from a 'natural' platform (A), and shaped the future core flank (a). All the following stages of the reduction sequence exploited the opposite platform (B). The first generation was launched along the ridge of intersection of flank (a) with the natural surface that would serve as the future coretable. This ridge shows limited traces of unifacial cresting. Platform (B) was then rejuvenated by a single core tablet removal to prepare it for the next generation of (laminar) flakes which gradually exploited the flank (b). One of the specimens of that generation could be refitted. According to the negative removals, the final products had somewhat recurved terminations. The core was abandoned at this relatively early stage.
4. Core/abandonment: Dim. 5.8 x 5.7 x 6.0cm. The core was certainly not exhausted, although further platform rejuvenation would have created a 'short' reduction face.

5. Productivity: Poor in terms of laminar output. Mainly a few large flakes. No tools refitted; no use-wear observed.
6. Quality of knapping: Mediocre.
7. Spatial layout: All elements, core included, are distributed in the dense Rekem 1 flint scatter.

Co-set 01c08 (Pl. 26; Map 35)

1. Refit state: A series of 10 blanks (fragments included) could be conjoined to the core. They provide a good illustration of the reduction system.
2. Original nodule: Dim. min. 7.4 x 10.0 x 7.5cm; coarse-grained good quality flint (type 1/20).
3. Reduction sequence: The distribution of negative removals on the outer surface of the reassembled volume does not reveal any careful preparation or preforming of this block. The refitted flakes, on the other hand, are quite systematically obtained from a single platform (A) along a wide reduction face (core table I). The platform was repeatedly reduced. The platform overhang on the single blade of the (refitted) sequence was also abraded. The major outputs of this extensive series were, however, thick flakes. Only the final refitted removal was detached from the opposite platform (B), after partial cresting of the flank (a).
4. Core/abandonment: Dim. 5.2 x 4.6 x 4.5cm. Morphologically a multi-platform flake core. The final flake scars have hinge terminations.
5. Productivity: A great number of artefacts, but seemingly only just a few laminar products. No tools refitted; no use-wear observed.
6. Quality of knapping: No apparent organisation of the volume, but still a relatively extensive production.
7. Spatial layout: All elements, core included, belong to the central flint scatter of Rekem 1.

Co-set 01c10 (Pl. 27; Map 35)

1. Refit state: 10 blanks refitted on a core document all stages of this limited reduction sequence.
2. Original nodule: Dim. 7.6 x 8.2 x 9.2cm; fist-size nodule of coarse-grained good quality flint (type 1/28) with several deep concavities.
3. Reduction sequence: The initial platform (A) and core-table (I) were created by the perpendicular removal of two large cortical flakes (only the core table preparatory flake has been refitted). The flank (a), on the other hand, was shaped by several cortical removals. Platform (A) was then facetted to prepare the primary laminar series, but the first detachment generated a large, partly cortical flake. Next, the knapper turned to the opposite side of the nodule to create a second platform (B). Removals from this side along flank (a) were more successful, *i.e.* included at least three blades. The core was abandoned at this stage, clearly before exhaustion.
4. Core/abandonment: Dim. 6.4 x 6.6 x 7.6cm. There is no obvious physical reason which would explain why the core was left so early on in the reduction process.
5. Productivity: Relatively poor. Not more than 5 blades. The truncation on one of these may have been provoked accidentally. There are no wear traces of use.
6. Quality of knapping: Mediocre. A stable laminar production could not be realised.
7. Spatial layout: As opposed to all other co-sets of Rekem 1, 01c10 was found in the less dense NE 'satellite' flint scatter.

Co-set 01c11 (Pl. 28; Map 36)

1. Refit state: 9 trimming flakes and 8 elements of the laminar reduction are refitted to their core. Although several elements are missing, the refitted specimens represent all stages of the production sequence.
2. Original nodule: Dimensions 11.2 x 7.3 x 6.4 cm (complete reconstruction); fist-size nodule of coarse-grained good quality flint (type 1/22).
3. Reduction sequence: This co-set represents a laminar reduction sequence generated from a single platform (A) that was renewed (at least) twice. The initial preparation of the volume consisted of the lateral removal of 3 large cortical flakes (2 refitted) from a flat side of the nodule, perpendicular to the later core-table (I). Apparently, they principally served to remove a few irregular features from that core-table. Next, a (rather oblique) platform was created on top of the nodule. This procedure at the same time produced a few large elongated flakes. The exploitation of the core table was launched along the intersection with the core flank (a), and continued towards the other side, till about half of the core perimeter was reduced. The last items of this laminar series are not refitted, so we ignore the reason for its termination. In any case, the next platform renewal substantially shortened the length of the core (to about half its original length) to prepare it for the next generation. None of the short blades of that final sub-sequence are refitted. One of the ultimate detachments clearly suffered from hinging.
4. Core/abandonment: Dim. 5.3 x 3.3 x 4.6cm. Heavily burnt single platform core. Its bottom, back, and one flank are still cortical. At least one negative removal presents a hinged termination.
5. Productivity: A suite of relatively thick blades. One of those received a few tiny burin blows (Pl. 76: 1). None of the artefacts has traces of use.
6. Quality of knapping: Systematic and rather successful laminar production.
7. Spatial layout: All elements cluster in the dense scatter of Rekem 1, essentially in its northern sector.

Co-set 01c12 (Pl. 29; Map 37)

1. Refit state: A conjoinment of a cortical trimming flake and 6 laminar products. Enough to provide

useful information on the reduction strategy.
2. Original nodule: Dim. unknown (min. length 6.4cm.); coarse-grained flint with irregular surfaces (type 1/26).
3. Reduction sequence: Several cortical flakes (1 refitted) removed from the front of the core created a unidirectional crest. The other side of the ridge was determined by a flawed fracture face. This procedure was followed by platform (A) preparation (not refitted) and the removal of a crested blade and a series of blades and laminar flakes from one end of the core. Five of the latter could be refitted. Further reduction is not documented.
4. Core/abandonment: unknown.
5. Productivity: A suite of short blades and laminar flakes. No tools refitted; no use-wear observed.
6. Quality of knapping: Difficult to judge from this limited reconstruction.
7. Spatial layout: All elements cluster in the northern sector of the dense scatter at Rekem 1.

Refitting of Rekem 1: general observations

While the total artefact number at Rekem 1 amounts to 4667 (Table 13), only 264 pieces so far have been conjoined. In the first place, this must be ascribed to the large amount of very small flakes (almost 3000 chips), which have not been involved in the refitting work. Second, however, we should confess that this assemblage has certainly not received the same rate of consideration as, for instance, Rekem 5, partly because the spatial potential of this small area initially appeared very limited. In all, it seems that considerably more refits are possible here. The large number of artefacts of flint type 1/21, for instance, suggests that co-set 01c01 has been only partly refitted. The original block in this case must have been quite large. On the other hand, the Rekem 1 assemblage includes a fairly wide range of flint types.

Debitage at Rekem 1 generally produced a range of short, but not too thick, laminar removals, often struck from one dominant striking platform (*e.g.* 01c02, 01c03, 01c05, 01c06, 01c08, 01c11, 01c12). The core flanks were almost systematically prepared. One set (01s42), however, deserves special mention here (Pl. 29). It was reduced from two opposed, very oblique striking platforms which were repeatedly renewed. The core was distinctly prepared with a central crest and the flanks were accurately maintained. Two of the final removals were modified as truncated blades.

Apparently, tool production at Rekem 1 focused primarily on the fabrication of burins and of lateral modified laminar pieces. Despite the recurrent integration of tools, however, none of the products refitted in the co-sets bear traces of use. This suggests that the locus was more a production place than a diversified activity area. Whether it also served as a dump zone deserves further discussion in chapter 6.

4.4.2.2 Rekem 4

Co-set 04c01 (Pl. 30; Map 40)

1. Refit state: A few (cortical) flakes and lumps. A very good representation of the complete reduction sequence.
2. Original nodule: Dim. 11.0 x 6.8 x 3.4cm; coarse-grained poor quality flint (type 4/20); an elongated cylindrical nodule with several internal flaws.
3. Reduction sequence: The naturally flat surface on one of the small extremities of the cylindrical volume was selected to serve as a striking platform (A) for the detachment of a small cortical flake along the convex elongated side of the nodule (opening core table I). After the intense renewal of platform (A), creating a more oblique face with respect to the core-table, the knapper produced a new cortical laminar flake along the core table (I). This operation apparently provoked the breakage of the nodule along a few internal flaws. Of the three broken fragments, the largest lump was selected for further reduction, exploiting the fracture facet as a core table (II). One of the laminar flakes could be refitted. The negatives on the striking platform indicated again intense rejuvenation (no refits).
4. Core/abandonment: Dim. 7.1 x 4.1 x 2.9cm. The last removals suffered from hinging.
5. Productivity: Poor, although the more regular blanks might be missing. No use-wear observed.
6. Quality of knapping: Difficult to evaluate from the present reconstruction. Apparently, there was no severe raw material selection.
7. Spatial layout: The artefacts are widely dispersed at Rekem 4, but whereas the blanks all occupied a northern position, the lumps and the core were clustered in the SW part of the locus.

Co-set 04c02 (Pl. 30; Map 41)

1. Refit state: 11 blade(let)s and 4 tablets refitted on the core. Good representation. Sets 04s01 and 04s02 almost certainly belong to this same reduction sequence.
2. Original nodule: Dim. min. 7.3 x 3.5 x 2.3cm; a small cylindrical nodule of coarse-grained good quality flint (type 4/21).
3. Reduction sequence: This co-set is a nice example of a very systematic opposed platform-reduction. The initial preparation of the platforms and the first stages of core table reduction were not refitted, but according to the negative removals, these operations did not consume much flint. The first refitted subsequence concerns a centripetal rejuvenation of platform (A). A few (unrefitted) removals were struck from this platform, but the flintknapper quickly turned to the opposite side of the nodule for the preparation of a second platform (B; not refitted), and the extraction of a suite of small blades and bladelets along core table (I). When some removals started hinging, the back of the core was also being

exploited (core table II), but it delivered only one cortical blade. After the renewal of platform (B) (core tablet refitted), another laminar series was launched. None of these elements could be refitted. The final stages of the exploitation almost continuously used platform (A) again, briefly interrupted for a few detachments from platform (B). These series flattened the residual volume considerably.
4. Core/abandonment: Dim. 4.6 x 2.3 x 1.6cm. Highly reduced volume.
5. Productivity: Relatively high, essentially small blades and bladelets. No refitted tools; no use-wear observed.
6. Quality of knapping: Successful exploitation of a very small cylindrical volume by the alternate use of two opposed platforms which were repeatedly renewed. Cresting was not applied, but was probably not appropriate in this case.
7. Spatial layout: All elements of this sequence, including the core, clustered tight (± 1 sq m) in the central area of Rekem 4.

Refitting of Rekem 4: general observations

Although not more than 2 days were spent refitting the Rekem 4 material, more than a quarter of the artefacts have been conjoined. It seems that just a few (coarse-grained) cobbles were (partially) exploited here. Co-set 04c02 represents remarkable bladelet production.

On the other hand, not a single 'domestic' tool from the Rekem 4 area could be joined with the refits. They seem to have been brought along as finished implements. Similarly, the blanks in fine-grained flint also seem to have been knapped elsewhere and imported as such.

4.4.2.3 Rekem 5

Co-set 05c01 (Pl. 31; Map 43)

1. Refit state: some ultimate blanks refitted upon their core (9 elements).
2. Original nodule: Dim. unknown (min. 9 x 6 x 3cm); coarse-grained good quality flint (type 5/21).
3. Reduction sequence: The exploitation of two opposite reduction faces was clearly oriented towards blade production, using a single platform (A) which was repeatedly (at least twice) renewed. On both sides, the reduction started along a ridge, formed at the intersection of two 'natural' surfaces: the cortex-bearing external surface at one flank (a) meeting an internal flaw (or the negative of a very large flake?) at the other flank (b). The first reduction face (I) is hardly used. The initial blank, which was guided by an unprepared ridge, slightly hinged and made that part of the core unattractive. The platform was then renewed (tabular flakes could not be refitted) and reduction turned to the opposite face (II). Here, it also started along the sharp edge of the intersection, and was then directed semi-peripherally (*semi-tournant*) along the cortical surface. A refitted crested blade in the middle of this series, demonstrates that the knapper tried to take care of the shape of the core, but the next attempts (not refitted) hinged, and the final blades surpassed (plunged) and exhausted much of the core length.
4. Core/abandonment: Dim. 5.0 x 3.5 x 2.8cm. Hinging and plunging created unsuitable surfaces and severely reduced the length of the core table. Part of the residual core still carries some chalk cortex.
5. Productivity: A fairly high number of blades and tools could be refitted: a scraper (Pl. 92: 12), a burin (Pl. 89: 05), an intentionally broken blade, and three more blades. Except for one of the latter that seems to have briefly served as a strike-a-light, none of the blades or tools show traces of use. However, the first detached flake of this co-set was used to cut dry hide. Moreover, although a physical connection could not (yet) be established, it is quite certain that another scraper (of thumbnail size, and used to scrape fresh/wet hide; Pl. 94: 2) also originates from this co-set.
6. Quality of knapping: Platform renewal and crest preparation are present, but these procedures did not prevent the blanks from hinging and plunging.
7. Spatial layout: The artefacts are mostly found in the SE part of Rekem 5 East. The core was situated somewhat more towards the centre of the concentration. The burin and the scraper join the other artefacts, while the broken blade moved some 5m northward.

Co-set 05c02 (Pl. 31; Map 43)

1. Refit state: 15 elements, including the core. Mostly lumps or poor quality products.
2. Original nodule: Dim. min. 11 x 4.5 x 4cm (good estimation); small sub-cylindrical nodule of coarse-grained poor quality flint (many natural breaks; type 5/213).
3. Reduction sequence: One of the extremities of the cylindrical volume was slightly modified to serve as the first striking platform (A). Since these primary flakes could be refitted, we assume that the entire reduction sequence was carried out locally. However, the first generation of blanks, which reduced the core to half its thickness, and met an important internal flaw, seems to be absent. The following (refitted) series turned to the prepared (but not refitted) opposed platform (B), and continued exploiting the same core table. The intersections of this table with the peripheral cortical surface served as guiding ridges. The first and several subsequent blanks of this series were heavily deformed by internal flaws. Still, the 'normal' reduction routinely continued. A (non-refitted) renewal of platform (B) preceded a second generation of this series, before the reduction again shifted to platform (A), producing a new generation that yielded but a few irregular blanks. Platform (B) then again served as the striking surface; the detachment of some lump-like blanks completely destroyed the residual core.

4. Core/abandonment: Dim. 7 x 4 x 2.5cm. Completely exhausted.
5. Productivity: Very poor. One (cortical) blade and 2 bladelets seem the only potentially useful elements. No traces of use-wear have been observed, however.
6. Quality of knapping: Poor. Uncritical choice of raw material and lacking initial shaping of the nodule.
7. Spatial layout: All artefacts are situated in the eastern sector of Rekem 5 West. The core and the three laminar elements take a central position, some 2m east of the hearth. Most of the small flakes are closer to the hearth, while the bigger lumps ended up in a peripheral position to the East.

Co-set 05c03 (Pl. 32-34; Map 44)

1. Refit state: With 87 artefacts, this co-set contains the highest number of refitted elements at Rekem, as well as the highest number of tools (N=16) and tool waste products (N=16). The sequence is almost complete (estimated number of artefacts = 100), but the core is lacking.
2. Original nodule: Dim. 14 x 9 x 12cm (good estimation); coarse-grained flint (type 5/24) of mediocre quality (internal natural flaw); the original morphology of the volume is a polyhedron.
3. Reduction sequence: Due to the natural shape of the nodule, the natural ridges and plane surfaces could be immediately exploited in a profitable way. The largest of these surfaces served without modification as the first striking platform (A) from which the reduction was launched along a sharp ridge (1), perpendicular to this platform. The extraction of this ridge blade initiates the first laminar generation, systematically exploiting a facet of the core that meets at a sharp angle with the striking platform, creating core table (I). This sub-sequence is discontinued when a second ridge (2) is arrived at, a ridge which is not intentionally profited from, but rather seems to function as a limit. No other ridges at that moment remained upon the core table (I), temporarily abandoned as a regular convex reduction surface.

The opposed platform (B), oriented perpendicular to (A), is then slightly prepared (broad cortical flakes), although here also, it should have been possible to exploit the natural surface without modification. The first blank of the laminar series struck from platform (B) again skirts ridge 2. Subsequently the core table (I) is progressively reduced, delivering mostly broader flakes (Pl. 34).

Platform (A), still unmodified, is returned to, and the exploitation of the core table (I) is progressively directed towards another ridge (3). Most of the blanks produced in this generation are overpassing (plunging) once a natural flaw within the body of the flint is reached. Only then was platform (A) slightly modified, affecting but a minimal part of the platform area. The next generation from this platform consists of only one short blade. A terminal small flake finishes the modification of platform (A) and the exploitation of the core at this side.

The polyhedron is then turned over to exploit on a new ridge (4) at the intersection of the (right) core flank (a) with platform (B). The ridge is used to initiate the preparation of the first (and last) crest of the entire sequence, using the core table (I) as the striking surface and progressively directing the preparation towards the initial striking platform (A). The next laminar generation produced from (B), commences with the removal of the crested blade, of which only a distal fragment could be refitted. It initiates a sub-sequence that reduces core table (I) from this crest to the ridge (2) – the latter once more functioning as a limit. The last blank produced was slightly hinged. A few large flakes rejuvenate platform (B) from which the debitage is resumed along the table (I). A sturdy blade from this generation could be refitted.

Again the core is turned to platform (A), from which the flaking of a large blank splits along a natural flaw, destroying the core table (I) and platform (A) except for a limited zone next to ridge (2). This remnant is utilised to produce another laminar series along the ridge (2): two generations are interrupted by a modest rejuvenation of what's left from the platform (A). The yet far reduced core is again turned and exploited from platform (B) along the ridge (2), yielding another blade and bladelet and 'exhausting' the core in this zone: as ridge (2) disappears, no sharp edge is left here. Instead of creating a crest at this side, a fresh ridge (6) is exploited, the latter formed at the intersection of the first striking platform (A) with the triangular flank (b). The extraction of a thick overpassing ridge blade initiates another series, using the reverse side of platform (B) as the striking surface, and both flank (b) and platform (A) as reduction faces. A slight rejuvenation of platform (B) divides the series into two generations. Finally the (refitted) reduction sequence is terminated with the removal of some flakes along the table (I) using the deliberated flaw (opposite to platform B) as the striking surface. The ultimate core being absent, it is impossible to say whether this sub-sequence effectively ended the reduction.

In conclusion, the debitage direction changed 7 times, twice accompanied by a platform modification, once by the preparation of a crest. Four more platform rejuvenations ultimately established 12 (laminar) generations. Although the reduction was conducted out of two principal platforms, this could not be determined from the remnant core (absent). During the later stages, one of the striking platforms (A) had been used as a core table while a natural flaw was also transformed into a striking platform.
4. Core/abandonment: Unknown. Dim. max. 5 x 6 x 5cm.
5. Productivity: In its present reconstruction, the reduction generated 20 blades (4 are fragmented), 3 laminar flakes (1 fragmented) and 1 bladelet. Most of these were transformed into tools, nearly all of which are burins (N=13; Pl. 78: 15; Pl. 79: 19; Pl. 80: 1-2,7; Pl. 81: 4-6, 9,16,18; Pl. 82: 2,6). The other tools – a truncated blade (Pl. 100: 12), an unidentified tool

fragment (Pl. 106: 4), and a large LMP (Pl. 70: 22; Pl. 75: 6) – may in fact also be associated with the burin category (see chapter 5). The burins could be completed with 16 burin spalls. In all, this implies that in 05c03 about 1 element out of 3 was modified or is tool waste. From a sequential point of view, most of these are situated near the beginning and near the end of the reduction: 5 burins within the first generation, 6 tools within the last three (modest) generations. Preferably blades were selected as support (for 12 tools), but also some less 'regular' products from the final generations were transformed, while some 'nice' blanks were on the other hand ignored (Pl. 34). Almost half of the burins (6/13), 2 burin spalls and 1 blade presented microscopic traces of use, all related to bone/antler work (5 for graving, 1 for sawing, 1 for boring, and 2 for undetermined actions).

6. Quality of knapping. This reduction sequence is a good example of a simplified laminar reduction method. Although the choice of the original nodule was not faultless (internal flaw), its polyhedral morphology was extremely useful to directly launch the proper laminar reduction (*plein débitage*). No preparation or pre-formation was needed as both a striking platform and a ridge were in an appropriate relative position available upon the natural stone, of which moreover most of the chalk-cortex had disappeared. All through the reduction only minimal preparatory steps have been applied to discretely modify a platform or to create a crest (only once). Still, many of the products obtained from this procedure were considered economically useful.

7. Spatial layout: Most of the artefacts cluster tightly in the central area of Rekem 5 East (one fragment only in Rekem 5 West). Except for a slightly more peripheral position of some burin spalls, the position of tools and tool waste is not different from the other artefacts. It seems that debitage of the nodule, and the production, use and discard of burins occurred on one single spot (with a centre in square N15E7), presumably in a relatively short period of time.

Co-set 05c04 (Pl. 34; Map 45)

1. Refit state: 18 artefacts, mainly cortical flakes, constitute a rather complete sequence. The core is missing, but was obviously very small.
2. Original nodule: Dim. min. 11 x 7 x 6.5cm; coarse-grained good quality flint (type 5/29), but morphologically a very peculiar block: the inside was entirely scooped by a deep cavity (*i.e.* completely hollow).
3. Reduction sequence: Fully neglecting the irregular morphology of the block, the reduction started parallel to the cavity and was conducted out of two opposed striking platforms. None of the platform preparations could be refitted. The first series, using platform (A), exploits one side of the nodule (flank a), partially decorticating it. The following blanks, produced from opposed platform (B), could not be refitted. Subsequently some flakes are laterally removed from the core table, and then two series are again produced along flank (a), alternating from platform (A) and platform (B). The third series from platform (A) starts exploiting the opposed side (flank b), initiating a similar platform alternation (ABAB) along this flank. Platform (B) was renewed only once in the course of this procedure.
4. Core/abandonment: Unknown.
5. Productivity: Poor. Mainly cortical flakes, only one blade. Due to the concavity within the core, some flakes also bear cortex on the ventral face. None of the refitted products served as tool-support. No traces of use-wear have been observed.
6. Quality of knapping: Notwithstanding the fanciful shape of the original nodule, the knapper generated a fairly regular alternating reduction sequence.
7. Spatial layout: The artefacts occupy a rather large sub-triangular area of about 6 sq m, situated between Rekem 5 West and Rekem 5 East. The Western edge coincides more or less with part of the peripheral belt around Rekem 5 West (*'effet de paroi'?*). It may be noteworthy that the area has a very low artefact density and that other refits only concern tested cobbles of extremely poor quality (crumbled). The distribution of 05c04 does not seem to have a real centre.

Co-set 05c05 (Pl. 35; Map 45)

1. Refit state: With 39 elements refitted, including the core, most steps of the reduction sequence are documented, but a considerable number of artefacts are (still) missing.
2. Original nodule: Dim. 17 x 9.5 x 9.5cm (good estimation); good quality coarse-grained flint with thick chalk cortex (type 5/23); almond-like form with some irregular protuberances.
3. Reduction sequence: Some of the earliest detachments could not be refitted. Although there is no indication of a systematic decortication process, the sequence started with the lateral removal of some large nub-like irregularities. On one extremity of the nodule, this process concurrently induced the installation of the first striking platform (A), terminated by the detachment of a large discoid flake. Platform (A) was used for the production of the first laminar series along the side that would permanently function as the single core table (I). The laminar series was temporarily interrupted for the lateral removal of a remaining cortical protuberance. Subsequently, a few blanks were struck from the core basis (B), obliquely exploiting the same core table, and using the back of the core as the striking surface. This process was hampered by some natural flaws in the body of the flint. An extensive laminar series was then introduced again from platform (A), subdivided into three generations by two platform rejuvenations. The terminal production from the last generation yielded some bladelets (not refitted). For a second time the reduction then shifted, to detach some final blade-

lets from the opposite side (not refitted), generating a core with two opposed striking platforms.
4. Core/abandonment: Dim. 4.9 x 4.6 x 3.1cm. Due to the continuous frontal reduction, the abandoned core still showed some cortex on its back. Except for the considerable reduction in size, there was no obvious reason for its discard.
5. Productivity: An important amount of tools could be refitted within this co-set: of a total of 39 products, 9 blanks were modified into 6 burins (Pl. 78: 11; Pl. 79: 2,5; Pl. 80: 3; Pl. 81: 13-14), 1 scraper (Pl. 94: 16), 1 composite tool (Pl. 105: 1), and 1 retouched piece (Pl. 106: 5), while 6 resharpening flakes (5 burin spalls) are also included. No critical selecting mechanism appeared to exist in choosing the supports: the 6 burins, for instance, were made on blade(fragment)s as well as on laminar flakes, flakes and a tabular flake. Some of the early cortical flakes were selected to serve also as supports. Many of the tools moreover were intensively rejuvenated, as is shown by the repeated resharpenings and their ultimate exhausted state. Some of these modifications and transformations (*e.g.* from bec to burin) could be well reconstructed and are presented in more detail with the tool description (chapter 5). The number of microscopic I.U.Z. (intentional use zones) on these pieces was quite elevated. Four burins and two burin spalls, the scraper, and the composite tool all served on bone or antler in various actions: scraping, sawing, graving, and boring.
6. Quality of knapping: Efficient removal of some irregularities from the block, instantly shaping out a suitable volume. The reduction systematically exploited a single frontal core table from two opposite directions. One direction clearly dominated, and only that platform was prepared and rejuvenated. Although the refitted products are altogether not very standardised, they clearly met required standards to serve as tool supports. Some of the more regular blades and bladelets moreover seem to be lacking.
7. Spatial layout: The scatter of artefacts constituting this co-set displays a semi-circular pattern with a focus in square metre 15N9E. The core was found near the centre. The tools do not significantly deviate from the general distribution. Again, as for co-set 05c03, we may assume a local development of the entire *chaîne opératoire*, including tool production, use, modification, and abandonment. Although the composition of tool types is more heterogeneous, it seems that again a single task was performed with the products of this sequence. Vertically, we should emphasise the important dispersion, to 75cm, of artefacts which, horizontally, are separated only 50cm. This phenomenon is considered in more detail in chapter 6 (section 6.2.7).

Co-set 05c06 (Pl. 36; Map 46)

1. Refit state: Mainly the initial stages of a reduction sequence are reconstructed (26 refitted pieces). The core and some of the blades produced are missing. Still, the organisation of this reduction is well illustrated.
2. Original nodule: Dim. min. 10.5 x 9.5 x 7.5cm (good estimation); coarse-grained good quality flint with a thin worn chalk cortex (type 5/210); ponderous protuberances.
3. Reduction sequence: The sequence is launched by the removal of some of the thickest knobs from the irregular nodule, producing thick and large cortical flakes. By doing so, two tangential planes are introduced, one of which served as the primary striking platform (A), while the other was used as a surface for the production of some (cortical) flakes, leading to the installation of a simple crest. Some of these preparatory flakes are missing. The blade-like removal of this crest initiated a generation of laminar reduction (3 blades, 1 laminar flake, and 2 flakes), producing the core table (I). This reduction surface was then knapped to renew platform (A), the striking surface from which one more, rather thick blank was produced. This flake partly destroyed the table (I). From the opposite side (hitherto the 'back'), the striking platform was again renewed and used to produce a new generation of blades along this new reduction surface (II). It eventually met the table (I), and thus a single peripheral core table was installed. Only one of the blades of this generation could be refitted. The striking platform was again rejuvenated, probably to allow another generation to be produced along the core table (II). Neither these blades nor the ultimate core could be found. The last two refitted flakes are laterally installed, possibly to prepare a new crest.
4. Core/abandonment: Dim. max. 7 x 4.5 x 6cm. No core found.
5. Productivity: The single element of this co-set that seems to show modification, concerns a flake produced during the preparation of the first crest. The position (distal) and type of retouch, however, suggest that it may well have been produced spontaneously. None of the refitted blades (N=4) were modified, but, as indicated, several more blades are actually missing. No traces of use-wear was observed.
6. Quality of knapping: In all, a fairly well elaborated blade technology has been applied, integrating primary shaping of the nodule (pseudo-decortication), several platform rejuvenations and (possibly several) crest preparation(s), all reminiscent of a classic blade debitage pattern.
7. Spatial layout: Most artefacts clustered in square 14N9E. The blades lay mostly at the edges of this concentration. One crested blade was transported to the central area of Rekem 6; a distance of about 12m.

Co-set 05c07 (Pl. 37; Map 47)

Introduction
Co-set (05c07) was made on a coarse-grained flint nodule (Total Dim. min. 10 x 9 x 8cm.) of mediocre quality with a worn cortex (flint type 5/28). Prior to its exploitation, internal natural flaws must have divided this nodule into (at least) 3 parts of compar-

4. Core/abandonment: Unknown.
5. Productivity: Efficient production of 11 well-shaped laminar flakes and blades. It seems surprising that none of these products was selected for tool-production. However, 'utilisation retouches' observed on two of them, suggested that the blanks were indeed utilised. This was clearly supported by the presence of microwear traces on 5 specimens, including both elements from Rekem 6. Interestingly, all were used as knives, with traces of cutting soft animal matter (meat, hide, tendons; N=2) or butchering (N=3).
6. Quality of knapping: Adequate laminar production. The installation of both platforms proved to be very appropriate, as these seldom needed renewal (only once during the entire refitted sequence). The rapidly inverted reduction of the core table from two opposite directions appeared to have been a very efficient procedure, yielding well-shaped laminar flakes and blades. As such, this co-set represents a rare example of a pure alternating reduction sequence at Rekem.
7. Spatial layout: As opposed to many other sequences, the artefacts of 05c09 do not display a clustered distribution. In addition to the first two laminar flakes which were found at Rekem 6 (10m distance), the blanks inside Rekem 5 are spread over a relatively large area. It seems difficult to reconstruct a possible knapping post – supposing that these artefacts were actually made locally in Rekem 5. Most likely, their dispersed position can be explained by individual transport, probably for reasons of use.

Co-set 05c10 (Pl. 39; Map 50)

1. Refit state: 12 refitted artefacts give a good impression of the reduction strategy.
2. Original nodule: Dim. unknown, min. 9.5 x 5 x 7.5cm; coarse-grained good quality flint with chalk cortex and one external flaw (type 5/21).
3. Reduction sequence: After the preparation (not refitted) of a striking platform on top of a more or less oval-shaped nodule, a perpendicular, narrow edge of the nodule was exploited to guide the production of the first series. As no cresting had preceded this, the first blank as well as the following laminar flakes produced along the sharp intersections of the core table with the cortex, were cortical. One tabular flake of the first platform rejuvenation could be refitted. It had been detached laterally, using the right flank of the core as the striking surface. Two more platform reductions were realised, subdividing the laminar series into at least four generations, all reducing the same core table. The 'good' (non-cortical) blades which must have been produced, are missing. Nor could the core be found.
4. Core/abandonment: Dim. unknown, max. 6 x 4.5 x 4cm.
5. Productivity: All laminar flakes and blades are cortical, but some present suitable edges. No tools refitted; no traces of usewear.
6. Quality of knapping: Simple laminar reduction, using a single striking platform (A) which was at least three times renewed. No special shaping of the volume (no crest preparation).
7. Spatial layout: The horizontal distribution of the artefacts displays a compact cluster on the southernmost edge of Rekem 5 East (near 12N, 8.5E), suggesting that this part of the sequence was knapped locally.

Co-set 05c11 (Pl. 40; Map 50)

1. Refit state: 12 refitted elements give a good impression of the initial stages of a reduction sequence.
2. Original nodule: Dim. unknown, but min. 10.5 x 7 x 5cm; coarse-grained good quality flint with partly a thin chalk cortex (type 5/210).
3. Reduction sequence: Removal of a laminar flake along a natural ridge on top of the nodule prepared the first striking platform (A). A cortical protuberance on the left flank (a) of the nodule was detached, and the laminar reduction started out of (A). It then shifted to an opposite platform (B), from which a crested blade was detached. The preparation of (B) could not be reconstructed. The direction of the reduction changed at least three more times to the opposite side, twice preceded by a platform rejuvenation, substantially reducing the length of the core. The core itself could not be refitted.
4. Core/abandonment: Dim. unknown, but max. 5 x 4 x 3cm.
5. Productivity: No well-shaped blades or tools could be refitted within this sequence, nor were there any traces of use. It is, however, possible that the more regular blanks are missing.
6. Quality of knapping: Adequate bi-directional alternating debitage, but with rather poor results.
7. Spatial layout: Most artefacts from the final sub-sequences are clustered in the central part of Rekem 5 East, at 14N8E. Other elements and especially the crested blade were found further East.

Co-set 05c12 (Pl. 39; Map 51)

1. Refit state: A single laminar series of 11 elements (mainly fragments).
2. Original nodule: Dim. unknown. Length min. 9.5cm; coarse-grained flint of mediocre quality, including several internal flaws (type 5/25).
3. Reduction sequence: Started with the removal of a crested blade, the present sequence corresponds with a single laminar series, out of platform (A). The striking platform was renewed (at least) once. Systematically starting along the ridge, the series mainly produced laminar flakes which were often affected by the internal flaws of the flint.
4. Core/abandonment: Dim. unknown, but max. length 6.5cm.
5. Productivity: Despite their restricted quality, several blanks had been selected for modification: one

truncated element and three burins (Pl. 78: 5,7,9; Pl. 89: 2; two are fragments of the crested blade) could be refitted within this sequence. None of these bear traces of usewear.
6. Quality of knapping: In spite of poor quality of the nodule, the knapper adequately prepared a platform and a crest, and succeeded in producing a few tools
7. Spatial layout: All artefacts, including tools and waste (one burin spall) are clustered in the central part of Rekem 5 East, near 15N9E (close to 05c03).

Co-set 05c13 (Pl. 40; Map 51)

Introduction
This (small) egg-shaped cobble had flawed into (at least) two parts after the removal of a few flakes from the top. Both parts were further reduced.
1. Refit state: Part A (8 elements) is well-documented; part B consist of 3 detachments only, but includes a scraper.
2. Original nodule: Dim. min. 7.2 x 5.0 x 3.5cm. Egg-shaped nodule of fine-grained, very good quality flint, with a thin cortex (type 5/11).
3. Reduction sequence:

Part A
The reduction started with the installation of the first striking platform at one of the small extremities of the half-cobble. The first generation had probably been initiated along the sharp ridge, formed at the intersection 'flaw plane/cortical surface', and had exploited part of both faces. These primary blade (let)s could not be refitted. A unidirectional crest was then installed along the contacting edge of the reduction surface with the cortex coat. Initiating a limited laminar generation, it was removed out of a second (opposed) striking platform (B), which had been only slightly prepared (not refitted). These operations allowed the knapper to regulate the distal curvature of the core table. Despite this precaution, all the bladelets from the next series, again produced from platform (A), hinged. The core was then abandoned.

Part B
Only 3 (cortical) flakes could be refitted from this sequence, showing unidirectional debitage with intense platform preparation. The largest removal was selected for scraper manufacture.
4. Core/ abandonment: Dim. 5.2 x 3.5 x 1.8cm (part A). Last negatives on core table show hinges.
5. Productivity: Poor with regard to the refitted artefacts, but some more regular blade(let)s are missing. One of the larger removals was transformed into a scraper and served for dry hide scraping (Pl. 93: 6). Other refitted sets of the same flint type including scrapers, suggest that the reduction was indeed intended for scraper production.
6. Quality of knapping: In spite of the small and unusual form of the nodule, various observations suggest that the knapper skilfully mastered the basics of blade technology: adequate installation of the primary platform, proper preparation of a secondary platform, and careful control of the core table convexity.
7. Spatial layout: Both parts are distributed over about 6 sq m in the northern half of Rekem 5 East.

Co-set 05c14 (Pl. 41; Map 52)

1. Refit state: Although only part of a sequence (16 artefacts) could be refitted, the objectives of the reduction strategy could be documented.
2. Original nodule: Dim. min. 12 x 6 x 5cm; coarse-grained good quality flint with chalk cortex (type 5/21).
3. Reduction sequence: This co-set does not include any of the very large blanks that must have been produced in a prior stage. Their negatives indicate that these blanks shaped an important part of the present reconstruction. Along their meeting with the cortical surface, a ridge (1) was formed which was used to guide the blades of the first two refitted generations. Those were detached from the first striking platform (A). Neither the installation, nor the first renewal of this platform, could be refitted. The direction of the debitage then shifted to the opposite side, where two refitted tabular flakes document the rejuvenation of platform (B). This procedure considerably reduced the length of the core. The following laminar generations subsequently produced out of (B), and again out of (A), produced rather short blanks. During the final (refitted) sub-sequence, platform (A) was also extensively renewed. The rest of the sequence, nor the core could be retrieved.
4. Core/abandonment: Dim. unknown, but min. 5 x 4 x 3cm.
5. Productivity: Next to some blades, a relatively high tool percentage was found amongst the refitted elements of this co-set. Five of 16 elements were modified: three scrapers (Pl. 92: 4; Pl. 93: 8,19), a bec (Pl. 102: 1) and a burin (Pl. 78: 10). Moreover, two fragments of a burin spall could be refitted. Two scrapers were made on tabular flakes, the third originally on a blade, but its modification considerably shortened the laminar support. All these scrapers were used for hide scraping, both the former on dry hide, the latter on fresh hide. The other tools were manufactured on a single large blade having had an original length of 11.5cm. Intentionally broken in two halves, the distal part was modified into a bec used for bone/antler boring. The proximal half of the blade was used for cutting fresh/wet hide, and resharpened by a burin blow on the broken edge. The burin spall largely passed over and removed most of the proximal part, bulb included. The burin bevel on the remaining fragment was still used again to cut fresh/wet hide.
6. Quality of knapping: Appropriate blade production, using two opposed platforms. No cresting needed.

able dimensions. Each of these volumes was then reduced separately, generating 3 separate cores (only 2 cores could be refitted). Although these three reduction sequences will be described as separate, independent entities (A,B,C), it is likely that they were, in a temporal sense, closely related. Therefore, the spatial layout of the three parts is presented compoundly at the end of the concluding paragraph.

Part A

1. Refit state: The 12 refitted elements give a good idea of the reduction strategy, but do not include the primary stages.
2. Original nodule: Dim. min. 9 x 7 x 5cm. (quality, see above).
3. Reduction sequence: The sequence started with the (unrefitted) preparation of a platform (A) and the installation of the first crest. The latter in fact only consisted of a slight modification of a sharp ridge formed by the intersection of the outer cortical surface and one of the natural internal flaws. In the course of the process, this ridge maintained its function as a starting point from which the different generations were initiated. The natural plane then served as a striking surface from which the ridge was modified into a unidirectional crest. Removal of the first crest seemed only partly successful. A very short crested blank came off, and the crest was immediately rejuvenated, a process that yielded a few cortical flakes. Before this second (but not secondary) crest was removed, the platform and the butt were slightly prepared. This preparation enabled the extraction of a thick crested blade with an equilateral triangular section, followed by the removal of a secondary crested blade, with remnants of cresting at its distal end only. The application of this sub-sequence must have required some technical know-how. However, it did not initiate any blade production. After the intensive repairing of platform (A) (tabular flakes could not be refitted), which produced a substantial shortening of the core, some final blanks were produced from this side. Only one flake of this sub-sequence could be found (at Rekem 6!). The preparation of a minor opposed platform (B) and the small production generated from it, no longer significantly altered the general outline of the core.
4. Core/abandonment: Dim. 5 x 4 x 3cm. Too small?
5. Productivity: Very poor. No blades, no tools, no traces of usewear.
6. Quality of knapping: Although characteristics of classic blade technology are present, the knapper generated rather poor products.

Part B

1. Refit state: 13 refitted elements, including the core.
2. Original nodule: Dim. min. 9.5 x 4 x 4cm. (quality: see above).
3. Reduction sequence: Again the intersections of natural planes were used as ridges guiding the blanks of the first generation. After preparation of the first striking platform (A) (not refitted), the intersection of a plane of flaw with the cortical surface served (without modification) as a guiding ridge for the first blank struck off from this platform. The ridge was then laterally modified, using the flaw plane as the striking surface, but the prepared crest was not extracted. Instead, the reduction shifted towards an opposite ridge, created this time by the sharp contact of two planes of flaw. An opposite platform (B) was implemented, and the ridge concerned was modified into a bi-directional crest. Flaking off this crested blade introduced a limited laminar generation. Its development grinded to a halt after one of the blanks which hinged shortly after departure, had taken too much of the striking platform, and made it ineffective. Finally, the knapper returned to platform (A) once more, to produce a few more blades along the same reduction surface.
4. Core/abandonment: Dim. 6.5 x 3 x 3.5cm. (seemingly exhausted)
5. Productivity: Poor: 3 blades, no tools, no traces of usewear.
6. Quality of knapping: same as for part A.

Part C

1. Refit state: 13 elements included. Core is missing.
2. Original nodule: Dim. min. 7 x 6 x 3.5cm.
3. Reduction sequence: Once more, the exploitation started with the (limited) preparation of a crest along the ridge and at an intersection of flaw and cortex surfaces. Its detachment initiated a blade series which, over and again, used the edge with the flaw surface to start a new generation. The series consisted of three generations, temporarily separated by two (refitted) sub-sequences of platform rejuvenation. Reading from the actual state of refitting, only one striking platform (A) appears to have been used. Only its initial installation could not be refitted. Neither could the core be found.
4. Core/abandonment: Dim. max. 5.5 x 3 x 2.5cm. Possibly a unidirectional core.
5. Productivity: Poor. No tools refitted. Some blades (2 refitted), no usewear.
6. Quality of knapping: same as for part A and B.

Conclusive remarks for co-set 05c07 as a whole

For the three reduction sequences, a similar system is applied:

1) In all three, profitable use was made of the ridges that emerged from the intersection of the two natural surfaces, either a plane of flaw and the cortical outside surface, or two planes of flaw. These ridges were sometimes slightly crested.
2) Platform rejuvenation is present, but only modestly.
3) The (combined) reduction surfaces consume at most half of the core perimeter.
4) Bi-directional debitage is attested twice. Refitting suggests (but could not confirm) a unidirectional debitage for the third sequence. Above all, however, the very reduced yield of 'appropriate end-products' may be considered the most common characteristic of the three sequences. Notwithstanding, elements of a classic blade technology were applied but only a

few blades were actually produced. The lack of blanks chosen as tool support is another indication for this poor result. The mediocre quality of the raw material as well as the reduced dimensions may be partly responsible, but cannot account for all these failing results.
7. Spatial layout: The technological affinity between parts A, B, and C of (05c07) is also mirrored in their spatial association in the southern part of Rekem 5 East. The core of part A joins this distribution, while the core of B is slightly separated, 3m to the West. One flake of part A was transported to Rekem 6.

Co-set 05c08 (Pl. 38; Map 48)

1. Refit state: The 37 refitted artefacts (core included) provide an adequate documentation of the reduction strategy applied.
2. Original nodule: Dim. 11 x 8.5 x 8cm (good estimation); coarse-grained good quality flint with a thin chalk cortex (type 5/21).
3. Reduction sequence: It is unknown to what extent the first striking platform (A) was prepared (not refitted). The cortical butts of the first laminar series, extracted from this platform, suggest that the preparation was certainly not very intense. The series started along an unmodified, 'natural' ridge. It exploited a limited part of the core table and produced cortical blanks only. The base of the core then served as an opposite (unprepared) striking platform (B) to produce a new laminar series along the same core table. Still many of these blanks were cortical. The reduction again shifted to platform (A) to produce another laminar series. The first two blades plunged and broke in at least two pieces, while the last blank (a laminar flake) split (*cassure de Siret*). Platform (A) was then definitely abandoned. In the course of the subsequent reduction, the opposed platform (B) continuously served as the principal striking surface. An important laminar series was first initiated along a sharp 'natural' ridge that was hitherto neglected (ridge 1). It introduced a new reduction surface (table II). After the rejuvenation of platform (B), the series continued first along the same core table (II) where a ridge was slightly modified into a crest. This delivered a primary and secondary crested blade. Subsequently the series continued along an opposite ridge (2), formed at the intersection of the cortical exterior and a former large negative. Twice more, striking platform (B) was renewed, once followed by a reduction subsequence along ridge (and core table) 1 only, the second time using both ridges 1 and 2 within a single generation. A reduced pyramidal core, semi-peripherally exploited and with only one striking platform (B) was left. The last blanks – bladelets according to the scars on the core – could not be refitted.
4. Core/abandonment: Dim. 4.3 x 3.5 x 3.3cm. No obvious damage on the core table (Pl. 12: 4).
5. Productivity: An estimated 60 to 70 artefacts were produced. Two scrapers (Pl. 93: 11) and a burin (Pl. 78: 18) could be integrated within this co-set, while edges were clearly damaged on two blanks. The burin was made on an overpassing laminar flake of the fourth generation and presents microscopic traces of bone or antler graving. The two scrapers were made on laminar flakes from the second and the eighth generation and served to scrape fresh/wet hide. The damaged edges were also found on laminar flakes. The co-set also generated a relatively high number of blades (about 10), but several of these had already broken during the reduction process. None of these were used. One flake, however, showed traces of a possible short use as fire-lighter.
6. Quality of knapping: Fairly high. The knapper knew how to direct a laminar reduction, using 2 opposed striking platforms. The second platform was the principal one during the second part of the sequence, where it was rejuvenated at least 3 times. Natural ridges were profitably exploited to initiate the different laminar series. Only once was such a ridge modified into a crest.
7. Spatial layout: When the core and the element from Rekem 6 are disregarded, the horizontal distribution of 05c08 displays an elongated, East-West oriented, ovoid form in the SE part of the concentration. Most of the debitage seems to be clustered in the Western part of this oval (at 13-14N, 8-9E), while the scrapers, some blades, and certainly the burin and its spall are in the Eastern part. The core was discarded some 3 m. to the North, while a big tabular flake, produced during the first rejuvenation of platform (B), was transported to Rekem 6, over 10m to the South.

Co-set 05c09 (Pl. 39; Map 49)

1. Refit state: 11 artefacts of full debitage only. No preparation, no core.
2. Original nodule: Dim. unknown, but min. length of 12cm; coarse-grained good quality flint (type 5/212).
3. Reduction sequence: Before the start of the refitted sequence (prior to introduction in the camp?), two opposed platforms were installed, and several blanks were removed from both sides. The first refitted blanks (elongated laminar flakes), detached from platform (A), were found at Rekem 6. The shift to the opposite platform (B) in the refitted sequence coincided with a move (of the nodule?) to Rekem 5. At least five more laminar series, each of only two to five blanks, and all separated by a successive platform alternation, were produced along the same reduction surface, generally exploiting about 1/2 to 2/3 of its length. Only the last series was preceded by a real rejuvenation (reduction) of the striking platform (B). A few blanks show traces of a moderate butt preparation, but most butts are plain. While the negatives of the blades suggest that even more series must have been produced, the blanks of only five of them could physically be refitted. Despite intensive search efforts, we could not find any more products, nor the core.

7. Spatial layout: Most of the debitage, the two scrapers made on tabular flakes, and the broken burin spall, are distributed in the SE sector of Rekem 5 East. The other scraper, the burin, and the bec, however, are somewhat separated in the NE sector of the same concentration. Vertically, these three tools are quite dispersed (difference of 45cm).

Co-set 05c15 (Pl. 41; Map 52)

1. Refit state: A connection of 14 cortical elements.
2. Original nodule: Dim. unknown (min. 13 x 12 x 6cm); coarse-grained good quality flint with substantial chalk cortex (type 5/211).
3. Reduction sequence: Since no unequivocal striking platforms or systematic debitage orientation can be specified, it is difficult to apply the standard set of definitions. The reduction rather developed out of different (opposed, but also lateral) directions, exploiting an important part of the nodule's cortical surface. During this process at most two or three flakes were subsequently removed out of a similar position: the direction mostly changed after each detachment, leaving a pattern that must have shaped a rather globular core. The refitted flakes are clearly from the primary stages of the reduction sequence which systematically decorticated the nodule. If cortex removal was the actual goal of this sub-sequence, such procedure has been rarely observed at Rekem.
4. Core/abandonment: No indications.
5. Productivity: A set of cortical flakes. No tools included; no traces of use.
6. Quality of knapping: Difficult to evaluate.
7. Spatial layout: Artefacts are mostly clustered in the N part of Rekem 5 East. The pattern conforms with a debitage scatter.

Co-set 05c16 (Pl. 42; Map 52)

1. Refit state: 13 refitted artefacts provide a comprehensive illustration of the reduction strategy.
2. Original nodule: Dim. 10.5 x 8.5 x 6.5cm; polyhedron with some internal flaws; coarse-grained flint with a completely eroded cortex (type 5/214).
3. Reduction sequence: The first refitted blank – a thick blade with a triangular section – had been detached along one of the sharpest ridges (1) of this polyhedral block, using a perpendicular natural surface as the striking platform (A). The cresting that had previously slightly modified this ridge without seriously affecting it, could not be refitted. This part of the nodule later became the back of the core (opposite to the future core table). A second crest was then prepared (partly refitted) upon a neighbouring ridge (2) and removed from the opposite direction. It left a large negative removal which was later used as striking platform (B) in the production of the following generation. It seems that this generation was initiated along yet another natural ridge and had generated some nice blades. However, these elements could not be refitted. The opposed platform (A) had then been prepared from the core table (preparation refitted), and used to exploit the same reduction surface (I). The intended laminar series was somewhat unsuccessful (several hinges). The knapper had then again tried to reduce platform (A), using the back of the core as striking surface, but was again confronted with hinging flakes. These 'accidents' apparently incited the knapper to abandon the core which at that moment was still quite voluminous, but which no longer presented adequate ridges.
4. Core/abandonment: Dim. 7.0 x 6.5 x 6.5cm. Several flaking accidents are visible.
5. Productivity: The refitted elements do not include standardised blanks or tools. The better flakes and blades could be missing. There are no microscopic traces of usewear.
6. Quality of knapping: Although the general concepts of laminar reduction were applied, and the irregularities of the volume profitably exploited (systematically using jagged edges at the intersections of the different faces as guiding ridges), the actual production was rather poor, and characterised by frequent hinging.
7. Spatial layout: The debitage clustered in the NW sector of Rekem 5-West, near the hearth, or (for two artefacts) at a distance of some 3-4 m.

Co-set 05c17 (Pl. 42; Map 53)

1. Refit state: 16 pieces, mostly well-shaped blades and fragments, refitted upon their core.
2. Original nodule: Dim. unknown; coarse-grained good quality flint (type 5/212).
3. Reduction sequence: The first stages of reduction could not be reconstructed. They included the complete removal of cortex, and the preparation of two opposed striking platforms. Two laminar series exploited the front core table (I), successively from the first (A) and the second (B) platform, yielding thin regular blades of which only a few could be refitted. Next, an extended laminar series was launched again from platform A, which throughout this procedure was renewed once, producing two generations of shorter blades. The second renewal of platform (A) was probably intended to head another generation, but the first trial quickly hinged, and core exploitation from this side was ended. A renewal of the opposed platform (B) preceded the last generation of this sequence, equally yielding some hinged blades.
4. Core/abandonment: Dim. 6.7 x 3.6 x 3.3cm. Flaking accidents (hinges).
5. Productivity: The refitted part includes 8 regular blades, but many more must have been produced. One blade was used to cut soft animal matter (meat, hide, tendons etc). No use-wear could be observed on the other blades. The co-set does not include modified pieces.
6. Quality of knapping: Efficient production of adequate blanks. The rapidly successive use of two

opposite platforms to reduce the core table yielded well-shaped blades. Each of the platforms was rejuvenated at least twice – by small detachments rather then by large tabular flakes – in order to maintain it in an acute angle with the core table. Some of these renewals shaped facetted butts. In terms of knapping quality, this sequence matches the debitage of co-set 05c09.
7. Spatial layout: Most of the debitage centred on the SW edge of the hearth in Rekem 5 West. Outliers found both to the West (a broken blade and the core) and to the East (the blade used for cutting meat, and a flake), contribute to an East-West oriented, elongated distribution pattern.

Co-set 05c18 (Pl. 42; Map 53)

1. Refit state: 9 artefacts refitted; mainly part of platform rejuvenation?
2. Original nodule: Dim. unknown; fine-grained, very good quality flint with thin chalk cortex (type 5/11).
3. Reduction sequence: This co-set is too limited to be sure of its exact position within the reduction sequence. Most likely, it represents the preparation of a platform, which, in that case, must have headed a narrow core. Small fan-shaped flakes with a distal cortical strip were detached from a (long) flank. A laminar generation (one bladelet refitted) then reduced the narrow core table. From the back of core, the platform was renewed, yielding two elongated tabular flakes.
4. Core/abandonment: unknown
5. Productivity: One small bladelet has been refitted, but more were probably produced. No traces of use-wear observed.
6. Quality of knapping: Difficult to estimate from this small reconstruction.
7. Spatial layout: Closely clustered in the N part of Rekem 5-East.

Co-set 05c19 (Pl. 42; Map 54)

1. Refit state: A conjoinment of 10 removals, including 1 burin.
2. Original nodule: Dim. unknown; fine-grained very good quality flint with thin chalk cortex (type 5/11).
3. Reduction sequence: The co-set reveals an irregular reduction, lacking any predominant debitage direction, aiming at the removal of thick cortical knobs from the nodule. The final detachment of this reconstruction – the only one without cortex – was transformed into a burin (Pl. 79: 20).
4. Core/abandonment: Unknown.
5. Productivity: Essentially flakes. The burin served for bone/antler graving.
6. Quality of knapping: Unknown.
7. Spatial layout: All elements, including the burin, were found in the SW sector of Rekem 5 East.

Co-set 05c20 (Pl. 43; Map 55)

1. Refit state: Although only 19 artefacts are conjoined, this co-set provides a very good illustration of the reduction strategy applied.
2. Original nodule: Dim. unknown, but min. 9.0 x 6.5 x 8.0cm; coarse-grained good quality flint with weathered cortex (type 5/27).
3. Production sequence: The preparatory stages of this reduction consisted of the installation of two opposite striking platforms. One platform preparation (B) has been refitted. This sub-sequence produced thick cortical flakes which removed a substantial protuberance from the nodule. The laminar reduction was launched from the first striking platform (A), along a sharp convexity of the cortical surface, generating cortical laminar flakes. The subsequent series, produced from the opposed platform (B), exploited the same area of the reduction surface (A). After renewal of platform (B), this series stops when the first blank of the second generation hinges (not refitted). Again drawing on (possibly rejuvenated) platform (A), a few large blades were produced. They plunged slightly and thus removed part of platform (B). Before renewal of the latter, an important (but not refitted) laminar series was produced from it, essentially reducing the right flank of the core table. Next, the removal of tabular flakes from platform (B), heavily reduced the length of the core. The remaining volume still generated a few (unrefitted) bladelets, one knapped from platform (B), but mainly reusing platform (A), which was meanwhile considerably reduced (no tabular flakes refitted). Despite its heavy reduction, the small remnant core was still (partially) cortical on its back.
4. Core/abandonment: Dim. 4.0 x 3.3 x 3.3cm. No visible scars of flaking accidents. The core was probably abandoned because of its small size.
5. Productivity: A few blades, but the more regular specimens are probably lacking. None of the refitted elements have been selected as tool-support; no use-wear observed.
6. Quality of knapping: Together, five laminar series are counted in a clearly alternating reduction system. At least four times (but certainly more), a platform renewal was implemented. There are no indications of cresting, but the careful core maintenance, and the quality of the products reveal advanced knapping experience.
7. Spatial layout: Distributed in the northern half of the central concentration in Rekem 5-East, more or less matching the distribution of (05c03).

Co-set 05c21 (Pl. 44; Map 55)

1. Refit state: 7 refitted artefacts, including the core.
2. Original nodule: Dim. min. 9.0 x 6.5 x 8.0cm; coarse-grained flint nodule, with a very irregular surface (many deep concavities) and several internal flaws (type 5/27).

3. Reduction sequence: Starting along a narrow (but not sharp) side, the knapper first removed some marked irregularities from two opposite directions, yet this procedure did not shape an appropriate core table. Other parts of the core were then exploited, but at the actual state of refitting, it is difficult to define the reduction strategy applied. By lack of any regular sub-sequence, possible preferential striking platform(s) cannot be located unambiguously.
4. Core/abandonment: Dim. 7 x 6 x 4cm. Some traces of hinging.
5. Productivity: Poor products, not selected for tool-modification; no traces of usewear.
6. Quality of knapping: Selection of a poor quality flint nodule and rudimental debitage.
7. Spatial layout: Concentrated in the central part of Rekem 5-East.

Co-set 05c22 (Pl. 44; Map 56)

1. Refit state: Limited reconstruction (7 elements, including fragments and burin spalls).
2. Original nodule: Dim. unknown (longest blade = 9.5cm); coarse-grained good quality flint (type 5/26).
3. Reduction sequence: Although certainly two opposed striking platforms were used, only the reduction from one of them (A) has been refitted. The series was launched along a natural ridge, and gradually exploited the left edge of the core table.
4. Core/abandonment: Unknown.
5. Productivity: Blade production. Two burins could be integrated in the sequence (Pl. 78: 8; Pl. 89: 4; Pl. 81: 7), each supplemented with one burin spall. None of the artefacts bear traces of use.
6. Quality of knapping: Adequate blade production.
7. Spatial layout: Distributed in the central area of Rekem 5 East. The two burins were located close to each other. One blade fragment descents from Rekem 6, but its exact position was not registered (not mapped).

Co-set 05c23 (Map 56)

1. Refit state: Limited reconstruction of 9 tabular flakes.
2. Original nodule: Dim. unknown; fine-grained good quality flint (type 5/12).
3. Reduction sequence: The co-set represents two consecutive rejuvenations of a single platform. The tabular flakes were removed centripetal. The intermittent debitage series along the core table (not refitted) did not affect the rhythm that can be recognised throughout the continued platform preparation.
4. Core/abandonment: Unknown.
5. Productivity: Only flakes refitted, none of them appear to be used.
6. Quality of knapping: Unknown, but platform installation reveals certain organisation.
7. Spatial layout: Clustered in the SW part of Rekem 5 East.

Co-set 05c24 (Map 56)

1. Refit state: Very limited (6 elements).
2. Original nodule: Dim. unknown; coarse-grained good quality flint (type 5/212).
3. Reduction sequence: Unidirectional exploitation of the smooth natural surface of a nodule without chalk cortex. The platform preparation that interrupts the series could not be refitted.
4. Core/abandonment: Unknown.
5. Productivity: Three cortical blades refitted. No traces of usewear.
6. Quality of knapping: Unknown.
7. Spatial layout: Clustered in the Eastern part of Rekem 5 East.

Co-set 05c30-05c32 (Map 56)

These co-sets are complete reconstructions of small crumbled flint cobbles, all found in the area of Rekem 5 West. The reason for their crumbling is not clear. There are no traces of burning. Some were clearly tested by a knapper, and it seems therefore most likely that they were suffering from internal natural flaws prior to their transport to the site, and shattered at the moment they were tested. The fragments were mostly found close to each other, but the distribution of these co-sets covers most of the Eastern sector of Rekem 5 West. Refit-sets 05s124 and 05s125 also belong with this category.

Refitting of Rekem 5: general observations

In terms of refitting, Rekem 5 by far presents the most comprehensive evidence. More than one third of the refitting artefacts from habitation zone 1 were found at this locus. It also includes the most copious co-sets, and a high number of refitting tools (as opposed to *e.g.* Rekem 10). This latter aspect will be discussed in chapter 5 and chapter 6.

The results are echoed in numerous refit sets which include several nice examples of well-organised bipolar debitage and which often demonstrate the abandonment of relatively large cores (*e.g.* 05s019, 05s020, 05s050). They are also reflected in a whole range of small sets which, although not (yet) physically connected, must certainly belong with one of the larger co-sets.

The reduction sequences at Rekem 5 display a remarkable variation in knapping quality. This ranges from well-organised elaborate sequences yielding appropriate laminar blanks (*e.g.* 05c09, 05c17, 05c20) – often selected for tool manufacture (*e.g.* 05c03, 05c05, 05c08) – to poorly developed productions of irregular flakes (05c02, 05c16, 05c21), which have repeatedly suffered from flaking mishaps (knapping accidents).

4.4.2.4 Rekem 6

Co-set 06c01 (Pl. 45; Map 59)

1. Refit state: Eight artefacts only could be refitted (including the core), but they provide an accurate illustration of the reduction strategy.
2. Original nodule: Dim. min. 8.5 x 8.5 x 7.5cm; fine-grained flint with a chalk cortex (type 6/12) and several internal cavities (invisible from the outside).
3. Reduction sequence: The exploitation started with the removal of some modest protuberances from various directions, producing thick cortical flakes. One of the scars was then used as striking platform (A), but the artefacts of the first laminar series suffered from internal cavities in the nodule. A second, opposite platform (B) was intensively prepared (not refitted), and used to generate a few thick laminar flakes. Once more the debitage direction was inverted, to produce a single blade only from platform (A).
4. Core/abandonment: Dim. 4.6 x 4.1 x 2.1cm. Two remnants of cortical cavities remained visible.
5. Productivity: Thick flakes, often cortical and irregular. One thick laminar flake was slightly modified and served for bone or antler scraping (Pl. 106: 8).
6. Quality of knapping: Mediocre. Application of some principles of blade technology, but poor results.
7. Spatial layout: All artefacts, including the core and the modified laminar flake are clustered in the SE part of Rekem 6.

Co-set 06c02 (Pl. 45; Map 59)

1. Refit state: 11 refitted artefacts, including the core. Good illustration of the reduction sequence.
2. Original nodule: Dim. min. 10 x 5 x 5cm; elongated nodule of coarse-grained black good quality flint with a thick but smooth brown chalk cortex (type 6/24).
3. Reduction sequence: The installation of the striking platform on one extremity of the elongated nodule, could not be refitted. The laminar reduction was launched along a sharp natural ridge. The first (cortical) blade could not be physically refitted either, but there are no indications of cresting. At least four generations of blades and laminar flakes were produced from the same side of the core (platform A), and they all exploited a single core table (I). Only three generations could be (partly) refitted. Some blade butts show careful facetting. The base and the back of the core were still completely covered with cortex when it was abandoned.
4. Core/abandonment: Dim. 5.0 x 3.2 x 3.7cm. No signs of flaking accidents.
5. Productivity: Three blades and some laminar flakes. No tools; no traces of usewear.
6. Quality of knapping: The co-set represents a most simple but efficient reduction system. With careful platform renewal and butt preparation, the knapper succeeded in a systematic unidirectional reduction of the core.
7. Spatial layout: All elements, including the core, are closely clustered in the central area of Rekem 6.

Co-set 06c03 (Map 60)

1. Refit state: Eight refitted flakes and fragments display an almost complete cobble.
2. Original nodule: Dim. min. 8 x 7 x 4cm; small coarse-grained flint cobble (flint type 6/20) of a very irregular shape.
3. Reduction sequence: Random flaking(?)
4. Core/abandonment: Unknown, but probably a very small core was left.
5. Productivity: Nihil (cortical flakes and lumps, not studied for usewear).
6. Quality of knapping: Selection of inadequate raw material, and lack of anything systematic.
7. Spatial layout: Distributed in the central part of Rekem 6.

Co-set 06c04 (Pl. 46; Map 61)

1. Refit state: Eight refitted artefacts, including the core, offer a crude image of the reduction strategy adopted.
2. Original nodule: Dim. unknown, but min. 6.5 x 5.0 x 3.5cm; coarse-grained good quality flint with a thick chalk cortex (type 6/22).
3. Reduction sequence: None of the initial stages of the core preparation could be refitted, but it seems that there was a careful organisation of the core volume. The striking platform was quite oblique *vis-à-vis* the core table, and it was also intensely facetted. The refitted series suggests that the reduction started in the central part of the core table and then gradually moved towards one of the sides. The blades exploited the complete length of the reduction surface, which in turn covered three quarters of the core perimeter. There are no indications of a crest preparation on the present state of refitting, nor are there signs of bipolar exploitation. The dimensions of the negative removals on the abandoned core suggest that the final stages of the reduction sequence generated numerous bladelets.
4. Core/abandonment: Dim. 4.1 x 4.4 x 2.1cm. No traces of flaking accidents visible on the core table.
5. Productivity: Two blades and a bladelet are refitted, but many more have certainly been produced. There are no tools included in the co-set, nor are there any used pieces.
6. Quality of knapping: Adequate production of a series of laminar products and skillful control of the core volume.
7. Spatial layout: The artefacts were spread in the eastern sector of Rekem 6.

Co-set 06c05 (Map 61)

1. Refit state: Two series could be partly reconstructed (6 elements).

2. Original nodule: Dim. unknown; coarse-grained flint with weathered chalk cortex (type 6/20).
3. Reduction sequence: The co-set connects elements of a bipolar reduction sequence. The first platform was probably abandoned because of the obtuse flaking angle. Several trials generated hinging flakes.
4. Core/abandonment: Unknown.
5. Productivity: Some thick and partly cortical elongated flakes were produced. One element received a few burin blows (Pl. 82: 11), but was left unused.
6. Quality of knapping: Mediocre. Poor control of the striking platform angle.
7. Spatial layout: Closely clustered (burin included) in the central part of Rekem 6.

Co-set 06c06 (Pl. 46; Map 62)

1. Refit state: Seven artefacts, including the core, document the final stages of a reduction sequence.
2. Original nodule: Dim. unknown; coarse-grained good quality flint with a weathered cortex (type 6/20).
3. Reduction sequence: None of the preliminary stages could be physically refitted, but there is no indication of an organised core preparation. The refitted co-set represents the production of flakes from various directions, using previous reduction surfaces as a striking platform.
4. Core/abandonment: Dim. 4.1 x 5.2 x 4.7cm. Globular morphology.
5. Productivity: Poor. One elongated flake. No tools, no traces of use.
6. Quality of knapping: Mediocre. Disorganised exploitation and poor results.
7. Spatial layout: Most elements, core included, clustered in the N part of Rekem 6. A large, elongated flake was found a bit further SE.

Co-set 06c07 (Map 62)

Partly reconstructed crumbled cobble. Two fragments show negative removals.

Refitting of Rekem 6: general observations

In terms of both quantity (13%) and quality, the refitting results at Rekem 6 are rather poor. The sets mostly consist of short series of thick flakes or lumps, or even of simple fracture refits. Exceptions are a few co-sets displaying very specific flint or cortex types (06c02, 06c04; see below). It is not impossible, however, that the present results fail as an accurate portrayal of the actual refitting potential. In fact, the Rekem 6 assemblage includes a considerable number of distinctive blades, but these are mostly made of very homogeneous grey flint, which we found very hard to conjoin. Some of the sets containing a core, equally show a clear laminar organisation (*e.g.* Pl. 13; Pl. 15: 2).

Co-sets 06c02 and 06c04 are good examples of a systematic unipolar reduction. It seems that there was no need to invert the debitage direction in those cases. The striking platform was kept sufficiently oblique by systematic rejuvenation and none of the blanks seem to have suffered from hinging. Generally, they travelled along the entire length of the core. Other co-sets (06c01, 06c05 and 06c06) present scarce core preparation and poor management of the volume in general, generating only thick flakes. Co-set 06c03, finally, is an example of awkward, inefficient debitage.

4.4.2.5 Rekem 7

Co-set 07c02 (Pl. 47; Map 65)

1. Refit state: With but 7 conjoined flakes, the sequence is far from complete. However, it gives an accurate impression of the primary reduction steps.
2. Original nodule: Dim. min. 6.8 x 9.5 x 11.2cm; coarse-grained dark grey flint with some lighter dots, partly covered with a thin chalk cortex. Several internal irregularities and flaws (flint type 7/23).
3. Reduction sequence: The co-set consists of a few thick flakes struck from various directions. Very large butts and thick bulbs point at the use of a heavy hard hammer. Some flakes were partly conditioned by natural flaws inside the nodule.
4. Core/abandonment: Unknown. Apparently, the core was not abandoned at Rekem 7.
5. Productivity: Extremely poor. Thick, unstandardised cortical flakes. No traces of use-wear have been observed.
6. Quality of knapping: Poor. Unorganised random flaking.
7. Spatial layout: Except for the first two very thick flakes ('chunks'), that were removed(?) a few metres east and south (in the direction of Rekem 13), all elements were situated in the NW 'lobe' of the Rekem 7 scatter (West of E34).

Co-set 07c03 (Pl. 47; Map 66)

1. Refit state: The eleven refitted elements come from various stages of the sequence, providing a general idea of the reduction project.
2. Original nodule: Dim.min. 11 x 9.5 x 8.5 cm; coarse-grained dark grey flint with some lighter dots, partly covered with a thin chalk cortex (flint type 7/23).
3. Reduction sequence: The first large removal of this reduction was struck along a natural flaw opening platform (A). The initial generation of cortical laminar flakes was perpendicularly produced along core table (I). The last blank consumed the entire surface of this side of the core. The knapper then further exploited this area, firstly to shorten the height of the core substantially (removal of several thick flakes), obtaining an appropriate regular platform,

and secondly to prepare a crest. Some of these preparations hinged. The next laminar series was initiated with the removal of a crested blade. Since the volume of the core had been reduced considerably, the (thick and large) laminar flakes of this series were hardly 5cm long and not significantly different from the preparatory blanks that shaped the crest. The last refitted products of this sequence are also of a comparable size, including a core side that fully removed the edge of the core table. It apparently initiated another laminar series with a completely different orientation, simply using the former core flank as platform, and the former platform as core table.
4. Core/abandonment: Unknown (probably not present at Rekem 7).
5. Productivity: Poor. Very thick, short (laminar) flakes. No traces of use-wear have been observed.
6. Quality of knapping: The very pronounced bulbs (with distinct bulb scars) and large butts on all products of this sequence point at the continuous employment of a heavy stone hammer. Although the output of the reduction was not very rich and included repeated hinging, the sequence seems to be well organised.
7. Spatial layout: Again, a few elements are separated (East and West this time) from most of the debitage, that was concentrated in the western 'lobe' of the Rekem 7 scatter.

Co-set 07c05 (Pl. 48; Map 66)

1. Refit state: A reconstruction of 7 elements, mainly tablets on a core.
2. Original nodule: Dimensions unknown; medium to coarse-grained yellow-grey flint with some very coarse inclusions (flint type 7/22).
3. Reduction sequence: The early stages of the sequence are not reconstructed, but apparently consisted of the preparation of at least one crest and two opposed platforms. The refitted co-set includes mainly the renewal of these platforms. Only one of the (final) exploitations of the core table could be refitted.
4. Core/abandonment: Dim. 5.4 x 5.6 x 4.8cm. The final attempt to renew a platform failed. Due to its oblique orientation, it destroyed a significant part of the core table (Pl. 16: 3).
5. Productivity: Ill known, but the core shows negatives of some well-shaped elongated elements. No traces of use-wear have been observed.
6. Quality of knapping: Mediocre? The knapper at least knew how to organise a bipolar laminar reduction project.
7. Spatial layout: Most participants, including the core, closely clustered in the NW-lobe of Rekem 7.

Co-set 07c06 (Pl. 72: 18; Map 67)

1. Refit state: Six products represent a small part of a reduction sequence.
2. Original nodule: Dim. unknown; medium-grained dark grey good quality flint with a brown band under a thin fresh chalk cortex (flint type 7/21).
3. Reduction sequence: The present reconstruction starts with a thick cortical flake that was probably struck to remove an embarrassing knob from the nodule. In fact, one of its sides shows traces of the hinging of former flakes. This in turn, affected some blanks of the next laminar sequence which could be partly refitted. This sequence consists of 4 (partly crested) blades, all struck from one side, but from different 'heights': the platform on this side of the nodule was each time renewed (total reduction of the core length = 4.3cm), leaving well-prepared butts on the blanks. The blank negatives show that the core was also alternatively exploited from the opposite direction.
4. Core/abandonment: Unknown.
5. Productivity: Regular blades and elongated flakes. One crested blade received a tiny burin blow (Pl. 72: 18; possibly at Rekem 1?), while the last refitted blade was transformed into a (broken) backed piece (Pl. 72: 18; Pl. 75: 7). No traces of use-wear have been observed.
6. Quality of knapping: Regular laminar production with adjusted crest preparation and platform renewal.
7. Spatial layout: Most of the refitted elements, including the broken backed point, were concentrated within 1 sq m in the central part of Rekem 7. One isolated laminar flake was located a few metres to the NE, while most importantly, the longest (crested) blade (burin) was transported to Rekem 1, some 20 metres to the North.

Co-set 07c07 (Pl. 48; Map 68)

1. Refit state: Since the 6 elements conjoined in this sequence document various stages and include the core, they provide a nice illustration of the reduction sequence.
2. Original nodule: Dim. min. 8 x 5.5 x 4cm; fine-grained 'Hesbaye' flint of fairly good quality with a battered chalk cortex (flint type 7/10).
3. Reduction sequence: In its initial stages, the reduction apparently exploited two opposed platforms. Their installation could not be documented, but the present reconstruction includes a flake struck from one side of the core (A), and a very thick cortical blade flaked from the opposite side (B). Much of the subsequent reduction is missing, but along its course, it shifted to a unipolar exploitation, leaving a pyramidal core with a cortical back. Two small blades of the final series could be physically refitted. There are no traces of cresting in the present reconstruction. The preferential platform was renewed at least twice.
4. Core/abandonment: Dim. 5.2 x 2.4 x 3.5cm. A few final attempts at platform renewal suffered from hinging (Pl. 15: 4).
5. Productivity: The sequence must have generated a series of regular blades with sizes ranging from 8cm to 4.5cm long (length of, respectively, the large (cor-

tical) blade from the beginning of the sequence and the last blade(let) produced). No traces of use-wear have been observed.
6. Quality of knapping: Systematic production and proficient output.
7. Spatial layout: All elements, including the core, cluster densely in the centre of the Rekem 7 scatter (Ø < 1 sq m).

Co-set 07c08 (Pl. 48; Map 69)

1. Refit state: 6 refitted elements document a laminar reduction.
2. Original nodule: Dim. unknown; medium-grained dark grey good quality flint with a brown band under a thin fresh chalk cortex (flint type 7/21).
3. Reduction sequence: The reduction proceeded from two opposed striking platforms which were used alternately in a fairly rapid rhythm: the few elements of the present reconstruction document 4 laminar series (two from each platform). Platform (A) was renewed once in this process. The exploitation of platform (B) was systematically preceded by a crest preparation. Thus, although there is no dominant platform, it should be noticed that both the thick crested blades were struck from platform (B). They conditioned the core volume most intensively.
4. Core/abandonment: Unknown.
5. Productivity: High, with regular blades, laminar flakes, and massive crested blades. Since both crests were modified into a burin (Pl. 77: 3; Pl. 75: 8; Pl. 84: 1; the former one at least partly at Rekem 1; 1 refitted burin spall comes from that locus), they should not be regarded as mere trimming waste. The burin from Rekem 1 was moreover intensely used (scraping and graving of bone or antler). On the other hand, a small (regular) blade struck from platform (A) was selected for lateral modification (Pl. 75: 4,8). It broke, however, before it was completed.
6. Quality of knapping: Regular laminar production with adjusted crest preparation and platform renewal.
7. Spatial layout: Most elements, including the burin and the backed piece, are situated in the NE part of Rekem 7. The multiple burin (or the blank on which it was made?) was transported 20 m. northward to Rekem 1. One of its (last) spalls was also found at Rekem 1.

Co-set 07c09 (Pl. 48; Map 70)

1. Refit state: A sequence of 6 blades.
2. Original nodule: Dim. unknown; medium-grained dark grey good quality flint with a brown band under a thin fresh chalk cortex (flint type 7/21).
3. Reduction sequence: The co-set consists of a laminar sequence produced from two opposed platforms. The first blade, struck from platform (A) was guided along a sharp ridge (1), partly covered with cortex. Cortical blades, which had been detached earlier, could not be refitted. The reduction then travelled in the other direction to meet a second ridge (2). Here it stopped to turn to the opposite platform (B), where the reduction started again along ridge (1). Only two small elements flaked from this side could be refitted, including a laterally modified blade. The orientation then changed again to platform (A), which was first renewed. Again, the exploitation of the reduction surface started along the same ridge (a). This time, however, the ridge was slightly modified (crested), but without affecting its shape.
4. Core/abandonment: Unknown.
5. Productivity: Regular blades. The edge of one blade was slightly nibbled (continuously). No traces of use-wear have been observed.
6. Quality of knapping: Regular laminar production with modest crest preparation and platform renewal.
7. Spatial layout: Except for one of the most regular blades, which had been transported to Rekem 1, all elements were abandoned in the E part of Rekem 7.

Refitting of Rekem 7: general observations

Whereas the refits at Rekem 7 are not very numerous (19% of the artefacts), they are mostly ventral-dorsal. Fracture refits are relatively scarce (*contra e.g.* Rekem 6), and often connect (accidentally) broken backed pieces. This may point at a short occupation, with little damage from trampling (further discussion in chapter 6).

A general distinction can be made between on the one hand a production of thick large flakes (07c02, 07c03, 07c05), and on the other hand, carefully executed, blade-oriented projects (07c06, 07c07, 07c08, 07c09). This dichotomy is also reflected in the spatial distribution (see chapter 6). The refit sets perfectly harmonise with the co-sets described above.

4.4.2.6 Rekem 10

Co-set 10c01 (Pl. 49; Map 73)

1. Refit state: This co-set is an almost complete reconstruction, including 29 blanks refitted onto the core.
2. Original nodule: Dim. 7.9 x 8.0 x 6.7cm; medium-grained good quality flint (type 10/22). The nodule was more or less spherical, but with a deep cortex-bearing concavity in one sector.
3. Reduction sequence: The circular ridge of the aforementioned cavity served as the initial striking platform (A), from where the reduction was launched along a perpendicular intersection of two ancient fracture faces. A series of some 10 laminar flakes and (short) blades (8 specimens refitted) was produced along this core table (I). Interestingly, all of the butts seem to have been prepared (facetted), apparently in order to remove the (rather thick) chalk cortex. One of the final detachments severely hinged and partly destroyed the core table. Reduction then continued

from the opposite side, where a very large ancient fracture face served as a suitable (cortex-free) striking platform (B). At this side, by contrast, hardly any of the butts have been modified. The series started with the detachment of a thick flake on one side of the (future) core table and exploited the core semi-peripherally (*semi-tournant*), interrupted only once for the lateral removal of a protuberance on the reduction face. Both generations of this series produced rather thick laminar flakes and, towards the end, also short blades. The final removal once more suffered from hinging, and the knapper decided to return to platform (A). After the removal of the remnant chalk cortex on that side, a few thin laminar flakes and blades were produced using the former back of the core as new core table (II). The latter, however, happened to be rather flat, and in view of the lack of useful ridges, the knapper started preparing a crest. After the removal of the crested blade the reduction ends at this side. Before the abandonment of the core, platform (A) serves again for the detachment of one final flake along a remnant 'natural ridge'.

4. Core/abandonment: Dim. 4.8 x 4.3 x 4.7cm. More or less exhausted.
5. Productivity: A considerable series of laminar flakes and blades. No tools refitted; no traces of usewear, but several pieces were altered.
6. Quality of knapping: Adequate production of laminar flakes and blades with a well-organised bipolar reduction and the occasional installation of a crest, all while constantly adapting to the momentary shape of the nodule.
7. Spatial layout: Most artefacts, including the core, cluster S of the hearth area, near the S edge of the habitation of Rekem 10. Several elements, *i.e.* 4 large laminar flakes, have been clearly removed (> 4 m.) to the N edge of the habitation.

Co-set 10c02 (Pl. 50; Map 74)

1. Refit state: Although it involves just 13 blanks (7 blades and 6 trimming flakes) refitting on the core, the co-set provides an excellent image of the reduction strategy.
2. Original nodule: Dim. min. 7.5 x 3.4 x 9.8cm; coarse-grained very good quality flint (type 10/20). The shape of the original nodule is unknown, but it presented at least one flat surface, functioning as the core's back. There is no cortex on the present reconstruction.
3. Reduction sequence: The first procedure physically documented is the preparation of a (unilateral) crest at one side of the nodule (flank a). Two of the flakes detached during this operation have been refitted. Next, a striking platform (A) has been installed (1 flake refitted), which served for the first (?) laminar reduction. No elements have been refitted, but reading from the negatives, this series must have produced a suite of long regular blades. The knapper then turned to the opposite side of the core, where a second platform (B) was installed (no refits). Again, a laminar series was generated from platform (B), starting with the detachment of the crested blade formerly shaped along flank (a). The core table (I) was semi-peripherally exploited. Considerable plunging of one of the blades apparently did not hamper further reduction. To the contrary, it created the increased convexity of the core table, which seems to have favoured the subsequent laminar production. It is not clear why this series was stopped. At a certain moment, however, the core was rotated 180° again, and platform (A) was rejuvenated. Probable detachments from this side could not be refitted, nor could any of the blanks provoked during subsequent renewal and use of platform (B) be found. The latter are partly known from the negative removals they left on the core tablet that was eventually detached from platform (B). It reduced the length of the core table to 4cm, but did not stop the sequence. The core was further exploited (from platform B) to complete exhaustion, precipitated by serious plunging of the final detachment.
4. Core/abandonment: Dim. 3.0 x 2.9 x 2.0cm. Completely exhausted.
5. Productivity: High. The reduction generated a suite of regular blades. Despite the apparent suitability for tool manufacture, none of the reassembled specimens have been modified. Neither did any of them show traces of usewear, but it should be noted that several pieces were too much altered for adequate microwear analysis.
6. Quality of knapping: High. The reduction face was shaped with an elaborated crest preparation, and the sequence was consistently organised from two opposite, adequately maintained striking platforms. The knapper successfully produced an abundant series of blades and was able to exploit the raw material to the maximum.
7. Spatial layout: The elements of this co-set are widely dispersed on the surface of Rekem 10. In general, however, the trimming products essentially seem to occupy the S part of the scatter, whereas the blades and the core occurred basically in the N half.

Co-set 10c03 (Pl. 51; Map 75)

1. Refit state: A conjoinment of 19 blanks, essentially flakes and mostly cortical. The core is missing.
2. Original nodule: Dim. 8.5 x 7.8 x 7.3cm; medium-grained good quality flint (type 10/23). A more or less spherical nodule, but with protuberances and occasionally profound cortex-bearing concavities.
3. Reduction sequence: The present reconstruction probably represents only the primary stages of the reduction sequence. The first removals have been struck from various directions and primarily served to remove some protuberances, simultaneously preparing a flank (a) and a striking platform (A). From the latter, a series of flakes and laminar flakes was launched along core table (I), which turned into a rather flat reduction surface. A second flank (b) was then reduced before a new series was generated from platform (A) along the intersection of core table (I)

and flank (b). This series provided a set of more regular blades. Subsequently, one large flake was detached along flank (a), before the knapper started exploiting the back of the core from an opposite platform (B), again generating more or less regular blades.
4. Core/abandonment: Unknown.
5. Productivity: Basically unknown. The present reconstruction contains a few (rather thick) blades. No traces of use-wear have been detected, but several pieces were too much altered.
6. Quality of knapping: Cannot be evaluated properly from the present state of the reconstruction.
7. Spatial layout: The elements of this sequence are fairly widely dispersed, but essentially along an elongated N-S axis, with a concentration in the N part (possibly near a second entrance of the dwelling).

Co-set 10c05 (Pl. 51; Map 76)

1. Refit state: A conjoinment of 10 elements, essentially broken flakes. Poor illustrative value.
2. Original nodule: Dim. unknown; coarse-grained good quality flint (type 10/20) with a thin chalk cortex.
3. Reduction sequence: The sequence starts with the removal of a few thick cortical flakes, possibly a platform preparation. The removal of one blade using this platform could be documented. The present reconstruction ends with lateral removals along what probably was the core flank.
4. Core/abandonment: Unknown.
5. Productivity: Unknown. One blade, broken in at least three parts. No traces of usewear, but several pieces were too heavily altered.
6. Quality of knapping: Unknown.
7. Spatial layout: Again rather widely dispersed, but essentially in the southern sector of Rekem 10.

Co-set 10c06 (Pl. 51; Map 77)

1. Refit state: A co-set of 9 small blades and bladelets refitting on the core. Good representation of the reduction sequence.
2. Original nodule: Dim. 6.5 x 6.0 x 1.9cm; coarse-grained good quality flint (type 10/24). A small flat slab with a triangular shape.
3. Reduction sequence: The strategy consisted of the alternating exploitation of the three narrow sides of the triangular slab. These small, elongated faces interchangeably served as striking platform and as core table. The first blanks refitted in the present reconstruction were detached from one angle (platform A) along core table (I). This series generated a few small blades (two are refitted). The distal end of the core table subsequently served as the new striking platform (B), from which some removals were launched along a second core table (II). None are refitted, but reading from the negative removals, the last extractions quickly hinged. The knapper then turned to the opposite side of the core table to use the third corner as the new striking platform (C). One of the first blades, removed along core table (II) slightly suffered from plunging, and the artisan continued with the creation of a unidirectional crest on the distal part of the reduction surface. Seemingly, this intervention primarily served to move the principal ridge more centrally on the dorsal face of the future blank. In any case, the crest perfectly guided the detachment of the crested blade that nicely travelled to the end of the core table. By contrast, the 3 following blades became gradually shorter. The core was again rotated 180°, returning to platform (B). An almost identical sub-sequence followed, *i.e.* the preparation and removal of a long crested blade, and the production of a few shorter blades. The subsequent series, alternatively detached from platforms (C) and (B), essentially produced a few short blades (only 1, detached from (C) has been refitted), and shifted the core table further upon the flat face of the slab (comparable with the effects of a flat-faced burin blow). Whereas the volume of the core was severely reduced at that moment, a final series of this production sequence still started exploiting the third side of the 'triangle' (core table III), using corner (C) of former core table (I) as a striking platform. These (unrefitted) removals also canted upon the flat face of the core.
4. Core/abandonment: Dim. 4.9 x 4.0 x 1.2cm. Broken in two halves and completely exhausted.
5. Productivity: A suite of small blades and bladelets. No tools refitted. No traces of usewear, but several pieces were too much altered.
6. Quality of knapping: Very efficient reduction of a small flat slab, by the appropriate exploitation of the natural layout of the nodule, but if convenient, also with a thoughtful application of cresting.
7. Spatial layout: The broken core(s) and a few blades are more or less 'concentrated' in the NE sector of the (hypothetical) dwelling of Rekem 10.

Refitting of Rekem 10: general observations

Although the refitting at Rekem 10 has not been unsuccessful (21% of the artefacts), there are just a few comprehensive co-sets. Most artefacts are conjoined in small sets, frequently in fracture or tooling refits. It should be remarked, however, that the general lack of variability in the flint types at this locus impeded effortless refitting.

With a careful selection of raw materials, appropriate preparation of the cores, and a rich output of short blades and bladelets, it seems that knappers at Rekem 10 were rather experienced. On the whole, the production seems quite different from what has been observed at *e.g.* Rekem 11. In fact, the output of 10c02 and 10c06 would perfectly suit in a context of LMP production (most lateral modified laminar pieces at Rekem 10 are from this flint type, but this also accounts for burins and scrapers). In overall terms, blanks are quite thin, and display a distinct laminar aspect. Crests, core flanks, and striking platforms were adequately maintained, and cores were intensely exploited (completely exhausted), generating a rich output, even from small nodules.

A somewhat more robust debitage, not as well-organised and with less elongated products, can be observed on co-sets 10c01 and 10c03 (and possibly 10c05). Strikingly, these raw materials apparently did not produce any tools. Their spatial distribution is also more concentrated (near the entrances of the dwelling?), whereas the products of 10c02 and 10c06 are widely dispersed throughout the dwelling. The spatial distribution of the refit sets agrees well with this general pattern.

A major contrast with the refitting results at Rekem 5 is that at Rekem 10, none of the co-sets, nor any of the sets including a core, contain burins or other tools. In other words, the refitting suggests that at Rekem 10, blanks selected for tooling were not knapped locally, but brought in as such, possibly in short series. The spatial distribution of the sets with burins also displays a different pattern: burins tend to cluster in the central part of the 'dwelling', whereas refitted debitage is situated more peripheral. Further discussion on this, and other topics follows in chapter 6.

4.4.2.7 Rekem 11

Co-set 11c01 (Pl. 52; Map 80)

1. Refit state: This reconstruction of 11 blanks on their core, provides a good illustration of the final stages of the core reduction.
2. Original nodule: Dim. Unknown (min. 8.5 x 5 x 9cm); coarse-grained grey good quality flint (type 11/23) with some very coarse inclusions.
3. Reduction sequence: The first steps of the sequence, including entire decortication, could not be refitted. The present reconstruction only illustrates the plain reduction, which seems to be organised from one predominant platform (A). However, the blanks produced during the repeated renewal of this platform are not very different from the laminar flakes obtained along the core table (I). Knapping series in both cases started along the sharp ridges that were formed by a large natural flaw on one side of the nodule and the core platform or core table on the other side (together, these three planes formed the upright part of a tetrahedron). Occasionally this procedure also created some limited unifacial cresting on the extreme upper part of a future blank. The present state of the reconstruction does not allow for a measurement of the surface exploited by the various laminar series, but they seem to have travelled quite far. The last blanks refitted reduced the opposite part of the core table, still from platform (A). A few negatives show that a few small blanks were also detached from the opposite platform (B), as well as from several other directions.
4. Core/abandonment: Dim. 5 x 4.5 x 5cm. Although some of the last blanks hinged, the actual cause of discard may have been the reduced maximum dimension of the core.
5. Productivity: Mostly flakes, some short blades. No tools refitted. No traces of usewear.
6. Quality of knapping: Although some regulation may be detected, it seems that decisions during the reduction process were largely taken haphazardly. Overall, the sequence reveals very little of a thoughtful organisation or planning of the volume. The procedure also led to a quick decrease of the length of the core.
7. Spatial layout: Nearly all artefacts cluster in 1 sq m on the eastern fringe of the main scatter of Rekem 11. The core had been discarded on the northern fringe of the same scatter.

Co-set 11c02 (Pl. 52; Map 81)

1. Refit state: This reconstruction of 7 blanks on their core provides a glimpse of the final stages of the reduction.
2. Original nodule: Dim. unknown (min. 6 x 7.5 x 3.8cm); coarse-grained good quality flint with some very coarse inclusions (type 11/23). It is not unlikely that 11c01 and 11c02 were originally two parts of a single nodule.
3. Reduction sequence: Judging from the refitted blanks and from the negatives on the core, the volume was reduced from various directions. A principal orientation cannot be observed: the refitted specimens were successively detached from 4 different perpendicularly oriented platforms.
4. Core/abandonment: Dim. 49 x 47 x 37cm. The core was found broken in two parts.
5. Productivity: Poor. Only flakes, no tools. No traces of usewear.
6. Quality of knapping: Unknown (limited reconstruction), but there is no apparent organisation of the volume.
7. Spatial layout: The artefacts, including the core, essentially occupied the same area as co-set 11c02, on the eastern fringe of the concentration.

Co-set 11c03 (Pl. 52; Map 82)

1. Refit state: Although just 3 flakes (one broken in 3 parts) refit onto their core, the refit is almost 'complete'.
2. Original nodule: Dim. 7.6 x 6.5 x 4.7cm; coarse-grained flint of rather poor quality, with numerous internal flaws (type 11/27).
3. Reduction sequence: A very 'simple' unidirectional reduction, launched along the smallest flank of the nodule (no cresting), and using a natural fracture face as the striking platform. As a consequence of the internal flaws, a few very thick blades were detached which immediately reduced the volume to diminutive dimensions.
4. Core/abandonment: Dim. 4.3 x 4.1 x 2.1cm. Small flat core. The final removals moreover suffered from hinging.
5. Productivity: Very poor; 3 thick cortical flakes and some short bladelets (not refitted); not studied for usewear.

6. Quality of knapping: Cannot be adequately evaluated, but in any case poor raw material selection.
7. Spatial layout: All elements, including the core, were found on the northern fringe of the scatter.

Co-set 11c04 (Pl. 53; Map 83)

This co-set consists of two sequences (A and B) which each exploited a part of a broken nodule (original dimensions min. 14.5 x 8.0 x 4.9cm.). Coarse-grained good quality flint (type 11/24). No internal flaws.

Part A
1. Refit state: 11 blanks refitted on the core. Good representation of all reduction phases.
2. Original nodule: After breakage, the remaining volume was a flat slab with a rounded outer surface (dim. 8.5 x 7.9 x 4.3cm.).
3. Reduction sequence: The very first removals are not refitted, but the negatives reveal that the primary series was launched from a 'natural' platform (A), without any preparation. One cortical flake of this series could be refitted. The reduction then turned to the opposite side, where the fracture face between part A and B served as striking platform (B). As the extension of this platform was limited, the reduction only exploited the narrow face of the core table (I), generating thick elongated flakes. Both this narrow face and the rest of the core table were further exploited from platform (A), which was intermittently also refreshed. When removals started to suffer from hinging at this side, the knapper again turned to platform (B), succeeding in the detachment of a thick laminar flake that consumed the entire core table length, and which was afterwards modified into a burin. The next blank, however, suffered from hinging again, and despite renewal of platform (B), there were no further production attempts.
4. Core/abandonment: Dim. 5.2 x 7.4 x 3.4cm. There are a few hinges on the core table, but a skilled knapper should have been able to continue the exploitation of this volume (Pl. 17: 2).
5. Productivity: Mediocre. Rather thick flakes and laminar flakes. The largest piece was modified into a burin (Pl. 85: 21). No traces of usewear.
6. Quality of knapping: In all, this co-set provides a good illustration of 'simple' alternating debitage, completely lacking in preconceived shaping of the volume (no cresting, no initial platform preparation), but generating a set of serviceable blanks.
7. Spatial layout: All elements, including the core and the burin were found in the eastern half of the main scatter of Rekem 11.

Part B
1. Refit state: One flake refitted the striking platform of a core
2. Original nodule: A cylindrical volume with one flat surface on top (dim. 7.1 x 4.1 x 4.5cm.).
3. Reduction sequence: Simple removal of thick cortical flakes from a single platform at both sides of the nodule. There was one attempt at platform renewal, but no further reduction.
4. Core/abandonment: Dim. 7.1 x 4.1 x 3.1cm. Poorly exploited core, mainly due to the reduced volume.
5. Productivity: A few thick flakes (not refitted).
6. Quality of knapping: Probably same knapper as part A.
7. Spatial layout: Only the core could be plotted on the map. It is located near the core of part A.

Co-set 11c05 (Pl. 53; Map 83)

1. Refit state: a sub-sequence of 5 flakes (probably representing only a small part of the sequence).
2. Original nodule: Dim. unknown; coarse-grained good quality flint (type 11/22).
3. Reduction sequence: Platform preparation (?) and production of flakes along one core-table.
4. Core/abandonment: Unknown.
5. Productivity: Thick flakes. One of these has been modified into a burin (two burin spalls refitted; Pl. 86: 03), and used for both scraping and sawing bone or antler.
6. Quality of knapping: Unknown. The butts of two blanks (including the burin) were intentionally prepared.
7. Spatial layout: All elements, including burin and spalls were located closely together in the far Western sector of Rekem 11 (the so-called 'burin area'; cf. chapter 6).

Co-set 11c06 (Pl. 54; Map 84)

An elongated, superficially knobbed, cylindrical nodule (dim. 13.5 x 6.4 x 5.5cm.) in coarse-grained flint (type 11/20) comprised a large internal flaw that provoked fracturing in two parts (A and B). Each part has been reduced to a limited extent.

Part A
1. Refit state: A small blade and a large broken cortical blade refitted on the core.
2. Original nodule: Dim. 9.0 x 3.5 x 3.8cm.
3. Reduction sequence: After detachment of a large flake (not refitted) from the top of the nodule, two opposed 'natural' ridges served to guide the removal of 3 (irregular) blades (2 are refitted).
4. Core/abandonment: Dim. 9.0 x 3.3 x 3.5cm. (*i.e.* hardly reduced). The final removal hinged.
5. Productivity: Extremely poor (irregular blades). No traces of usewear.
6. Quality of knapping: Unknown. Very fortuitous approach.

Part B
1. Refit state: Although just a few elements are refitted, this limited reduction-sequence is well-documented.
2. Original nodule: Dim. 8.9 x 4.3 x 4.9cm.

3. Reduction sequence: Both extremities of this slab have been exploited, but the chronological order is unknown. The first removal on one side was detached from a 'natural' platform (A), guided along a ridge formed by the meeting of the cortical surface with the large fracture face (see above), and initiated core table (I). All the following removals (± 8 small blades; 2 are refitted) consumed the same platform (A) and core table (I). The final items are severely hinged. Reduction on the opposite extremity consisted of one platform 'preparation' (B) and the removal of a large thick flake along the cortical flank (very much like part B of 11c04).
4. Core/abandonment: dim. 8.6 x 4.4 x 4.9cm. Despite hinges on one core table, the volume was certainly not exhausted.
5. Productivity: A few small blades. No traces of usewear.
6. Quality of knapping: Basically unknown, but there are no indications of an elaborate organisation.
7. Spatial layout (of both parts A and B): All elements are dispersed in the eastern half of the main Rekem 11 scatter. Both the cores are situated on the eastern edge, together with most of the other cores of Rekem 11.

Co-set 11c07 (Pl. 54; Map 85)

1. Refit state: With just a few blanks refitted on a core (fragment), this co-set documents only a part of the reduction.
2. Original nodule: Unknown (min. 8.7 x 7.1 x 3.1 mm.); coarse-grained dark flint (type 11/25) of deficient quality (several internal flaws).
3. Reduction sequence: The part of the sequence documented here reveals a unidirectional reduction from platform (A) along core table (I). The latter is very narrow (± 2cm) on the present reconstruction, but may have been larger in case the splitting of the nodule along the natural flaw occurred during a final stage of the reduction only. One final (non-refitted) removal was launched along the back of the core. The largest blank of the sequence was manufactured into a (double) burin, and intensely 'consumed'.
4. Core/abandonment: Dim. 6.6 x 4.0 x 2.1cm. Several 'natural' fracture faces reduced the residual core to a flat slab, unsuitable for further reduction.
5. Productivity: At least a few blades have been obtained. One was modified into a burin (Pl. 86: 10) and served for graving bone or antler.
6. Quality of knapping: Unknown (poor raw material selection).
7. Spatial layout: Blanks, core, burin and retouch flake were all located in the centre of the scatter at Rekem 11.

Co-set 11c08 (Pl. 73: 23; Map 86)

1. Refit state: Sequence of 4 (broken) blades.
2. Original nodule: Dim. unknown (min. length = 9.5cm); coarse-grained good quality flint (type 11/20) with at least one cortical inclusion.
3. Reduction sequence: The present reconstruction is an excellent example of an opportune, efficient knapping procedure. The reduction was launched from an unmodified platform along a 'natural' crest-like ridge. Both flanks equally consisted of the outer surfaces of the original slab (with chalk cortex at one side). The final product of the sequence was modified into a large backed pointed blade.
4. Core/abandonment: Unknown.
5. Productivity: Rich (all blades). The proximal part of the backed specimen was used as a butchering knife (Pl. 73: 21-23).
6. Quality of knapping: Successful exploitation of a flat part of a slab.
7. Spatial layout: All elements in centre of Rekem 11 (same distribution as 11c07).

Refitting of Rekem 11: general observations

In quantitative terms, the refitting results at Rekem 11 are very similar to the results obtained at Rekem 7 (20%). Most artefacts are conjoined in co-sets, or in sets including a core (14 of 16 cores are refitted here!). There is a remarkable recurrence of broken blocks of which the separate parts were further reduced.

Debitage at this concentration was rather concise, and not elaborate (no cresting, very poor laminar production). In fact, this seems somewhat surprising in a locus which was apparently focusing on the fabrication of lateral modified laminar pieces (see chapter 6). On the other hand, there is clear evidence of burin production, though not of extended series as at Rekem 5, but rather at a rate of one burin per sequence.

4.4.2.8 Rekem 12

Co-set 12c01 (Pl. 55-56; Map 89)

Introduction
Co-set (12c01) was made on a large, elongated coarse-grained flint block (total dim. min. 25 x 15 x 15cm) of irregular quality (many very coarse inclusions) and with a fresh chalk cortex (type 12/21). Prior to exploitation, the nodule had split along internal natural flaws into (at least) 4 parts. One fragment was left unexploited; the three other volumes were reduced to a variable degree. Only two of those could be partly refitted (1 core included); the third sequence is represented by one flake only. The 4 parts will be considered here as separate, independent entities (A, B, C, D). Their spatial layout is described compoundly at the end. As a whole, this co-set includes 34 elements.

Part A
Although it could have been exploited, this chunk (dim. 9 x 7 x 4cm) was left untouched.

Part B

1. Refit state: With 8 refitted pieces, including the core, the reduction system is sufficiently documented.
2. Original nodule: Dim. min. 9 x 11 x 4.6cm. (quality, see above). Along its narrow sides, this flat chunk displayed two opposite sharp ridges and two opposite planes.
3. Reduction sequence: Without any preparation, the reduction instantly opened table (I) with the detachment of two blades along one of the natural ridges, and using a perpendicular natural plane as striking platform (A). The core was then inverted, and the opposite surface was used as striking platform (B) to produce another limited laminar series (one blade refitted). Next the knapper returned to platform (A), which was slightly readjusted to prepare the next series (no blades refitted). In the final stage, the opposite ridge was exploited from platform (B), creating core table (II), but only a few irregular laminar flakes were generated.
4. Core/abandonment: Dim. 7.5 x 6.5 x 4.6cm. The core was abandoned in an non-exhausted stage.
5. Productivity: Poor. Some irregular cortical blades with a triangular section were produced. No traces of usewear.
6. Quality of knapping: Mediocre. Principles of laminar reduction were applied, but with poor results.

Part C

Only one flake of this part could be joined in co-set 12c01.

Part D

1. Refit state: With 24 refitted artefacts, the reduction sequence of this co-set is well-illustrated.
2. Original nodule: Dim. min. 9 x 11.5 x 9.5cm; a rather thick but irregular volume, probably the largest fragment of the nodule (flint quality, see above).
3. Reduction sequence: In the beginning of the sequence, the direction of the reduction shifted almost constantly. It is difficult to give an accurate description of these stages which only generated irregular flakes. After a certain time, the knapper started using a principal striking platform (A) and exploited the core table semi-peripherally, mostly producing large short flakes. The platform was rejuvenated once by the removal of a large core tablet. In the next generation, the flakes gradually became smaller and more elongated. The two last artefacts which could be physically refitted in the sequence, are small blades.
4. Core/abandonment: Dim. unknown (max. 6 x 5 x 5cm).
5. Productivity: Poor. Very few blades. No tools. No traces of usewear.
6. Quality of knapping: Mediocre. It took a lot of energy and raw material before the volume was made suitable for blade production, which apparently was the final goal. There are no indications of crest preparation. The co-set further includes several thick, hinged or broken flakes.

Conclusive remarks for co-set 12c01 as a whole

The 2 sequences (B and D) of this co-set which could be substantially refitted, at first sight display a different reduction system: production of thick blades in part B, flakes in part D; use of two opposite core tables and bipolar extraction in part B, unipolar and semiperipheral exploitation in D, etc. If both parts were reduced by the same flint knapper, this co-set nicely illustrates how different original morphologies of parts B and D invoke different types of reduction.

7. Spatial layout: Together, the artefacts of 12c01 stretch out over a large part of the concentration. However, part B seems more closely distributed in the S part of Rekem 12. The last (and most regular) blade produced is somewhat separated to the North.

Co-set 12c03 (Pl. 57; Map 90)

1. Refit state: 5 blades and 2 flakes refitted on the core provide an accurate illustration of the reduction system.
2. Original nodule: Dim. min. 14 x 14 x 3.4cm; coarse-grained flint with very coarse inclusions and a thick fresh chalk cortex (type 12/22). A flat nodule with a convex cortical surface on one side and a flat fracture surface on the other side.
3. Reduction sequence: The reduction started with the installation of a striking platform on the sharp ridge of the nodule. Small cortical flakes were detached from the fracture surface. Perpendicularly, along the intersection cortical face/fracture face, a laminar series was produced that generated thick blades with a triangular section, covered with cortex on one side of their dorsal face. The first refitted blade was slightly crested. Throughout this series, the platform was constantly renewed, both laterally (from the fracture face), and frontal (from the core table). Both preparations are visible on the asymmetrical butts of the blades.
4. Core/abandonment: Dim. 9 x 9 x 3.4cm. It is not clear why the core was discarded in this stage. There are no traces of flaking accidents and the core still had a workable volume (Pl. 18: 1).
5. Productivity: Except for the small preparatory flakes, only massive blades were produced. No tools refitted. No traces of usewear.
6. Quality of knapping: Very efficient unipolar production of massive blades.
7. Spatial layout: The core and the 5 blades tightly clustered in an area of about 1/16 sq m on the S edge of Rekem 12. By contrast, the two small platform preparation flakes were separated by a few metres to the NW. This suggests that the core and the blades were deliberately kept together, perhaps in a cache, a pattern seldom observed at Rekem.

Co-set 12c04 (Pl. 58; Map 91)

1. Refit state: Eight refitted artefacts, including the core, provide a general outline of the reduction procedure.

2. Original nodule: Dim. min. 7 x 7 x 7cm; fine-grained good quality flint; cobble of a spherical shape, with a weathered cortex (type 12/11).
3. Reduction sequence: The installation of the primary striking platform (A) and the initial exploitation of the core table (I) are not refitted (co-set 12c05 may partly represent these processes, but could not yet be physically conjoined with 12c04). A slight modification of the core side (unidirectional cresting) can be recognised on the first laminar flake of the refitted sequence, but this process did not alter the shape of the core significantly. A few more blanks were detached from platform (A), but when those started exploiting only part of the core table length, the knapper shifted to the opposite side. A second platform (B) was created there by the simple removal of a single cortical flake. Several laminar blanks were then detached from it (the refitted elements are flakes). Most blanks of the following reduction sequence are missing, but reading from the negatives, a systematic and intensive bipolar exploitation of core table (I) took place. Throughout this process, the striking platforms were hardly rejuvenated. One core flank (a) was slightly reshaped.
4. Core/abandonment: Dim. 4 x 4 x 2.5cm. As no traces of flaking accidents or internal irregularities are detected, it may be assumed that the core was abandoned because of its reduced dimensions.
5. Productivity: The refitted sequence includes a few laminar flakes, but it is likely that better elements (possibly bladelets) were also obtained. No tools have been refitted (but see 12c05). No traces of use-wear.
6. Quality of knapping: Efficient bipolar exploitation and adequate production of short blades and bladelets.
7. Spatial layout: Most elements, including the core, closely clustered on the S edge of Rekem 12. A small tabular flake was found some 3m further to the NE.

Co-set 12c05 (Pl. 58; Map 92)

1. Refit state: A series of 7 blanks detached from 2 different directions.
2. Original nodule: Dim. unknown; same raw material as 12c04 (type 12/11).
3. Reduction sequence: Although the general context of this limited sequence is not reconstructed, it is likely that the first three flakes represent the preparation of a platform. A generation of laminar flakes was then detached from it.
Presumably, this co-set documents the earlier reduction stages of nodule 12c04.
4. Core/abandonment: Unknown.
5. Productivity: A few cortical, laminar flakes were produced. One of them was transformed into a burin on truncation (Pl. 87: 9). No traces of usewear.
6. Quality of knapping: Difficult to assess, but see 12c04.
7. Spatial layout: 6 elements were located in exactly the same area as most of co-set 12c04 (S edge of Rekem 12). The burin was removed some 3 metres to the East. No use-wear traces were detected on it, nor on the other elements.

Refitting of Rekem 12: general observations

The refitting results at Rekem 12 (18% of the artefacts) remain slightly under average. However, according to the associated raw materials, more conjoins must be possible. Many sets presumably also belong with co-sets 12c01 or 12c04. Because of its partly disturbed character, this concentration admittedly did not receive as much attention as *e.g.* Rekem 5 during the refitting process.

In terms of raw material, the knappers repeatedly exploited rough, irregular flint blocks (often slabs), with some internal cortex, and numerous flaws. It seems difficult to clearly distinguish different levels of knapping quality at Rekem 12. Although the 'mediocre' quality of co-set 12c01, part D, produced a lot of 'waste' for just a few 'appropriate' blades, the sequence eventually arrived at a more or less systematic unipolar blade production. Conversely, the effective production of blades in co-set 12c03 was alleviated by the suitable original morphology of the nodule (with its unipolar reduction, and maintenance of the flanks, this co-set finds parallel with debitage at Rekem 1). Finally, the quality of co-sets 12c04 and 12c05 could meet both of the former. On the other hand, some refitted sets (*e.g.* 12s02; Pl. 58) also point to a production of well-prepared, rather elongated blades.

4.4.2.9 Rekem 13

Co-set 13c01 (Pl. 59; Map 96)

1. Refit state: The 16 blanks refitted represent only a part of the reduction sequence.
2. Original nodule: Dim. min. 12 x 10 x 7cm; coarse-grained good quality flint (type 13/21). One flank of the nodule was cortical, while others were mostly flat fracture surfaces.
3. Reduction sequence: The first (cortical) blanks of the series are lacking. The present reconstruction pictures mainly the detachment of a few large flakes, exploiting an unmodified natural fracture surface as striking platform. All these flakes have large unmodified butts. Several flakes are broken and the last ones hinged. Apparently, they were meant to shape the flank of the volume and to create striking platforms at both ends. However, it remains unclear why such a large portion of the block had to be taken away. The refitted blade, struck from platform (A) along the former striking surface, was possibly the first of a laminar series, but the rest of the reduction could not be reconstructed.
4. Core/abandonment: Unknown.
5. Productivity: Next to the blade, which possibly was the first of an (exported?) series, the sequence

yielded several massive flakes. No tools; no traces of use.
6. Quality of knapping: Hard to tell, since the most significant part of the reduction is possibly missing, but hinging of several flakes may be an indication of mediocrity. Otherwise, this refit may represent the initial stages of an adequate shaping procedure.
7. Spatial layout: Most elements are highly concentrated in the Rekem 13 scatter. Some are situated slightly closer to Rekem 7 (possibly affected by a structure dating to the Roman period).

Co-set 13c02 (Pl. 59; Map 97)

1. Refit state: The 21 blanks and one core fragment give a good impression of the reduction procedure before breakage of the core.
2. Original nodule: Dim. min. 10 x 6.5 x 7cm; a slab of coarse-grained good quality flint with cortical and old fracture surfaces (type 13/21). One internal flaw appeared during the reduction sequence.
3. Reduction sequence: The knapping started from an unmodified surface (platform A) along a natural ridge formed by the intersection of a cortical flank and an ancient fracture face, producing thick blades and some elongated flakes. The striking platform was slightly modified twice. This first laminar series exploited a rather narrow part of the slab, flanked by a regular cortical surface on the left, and a more irregular surface on the right. The irregularity on the right flank (a slight elevation) was removed (cresting) before that part of the core was equally exploited. The knapper then turned to the other side of the core to produce some blades from platform (B). Maintenance at this part of the core has not been reconstructed. Platform (A) was used once more, but without appropriate blade production. An internal flaw induced breakage of the core, possibly when blade production started from (B) again. This apparently compelled the knapper to abandon further production. No further refits were found at Rekem 13.
4. Core/abandonment: Dim. 5.5 x 6.5 x 4.5cm.
5. Productivity: A few larger blades were produced. No tools; no traces of use.
6. Quality of knapping: Successful exploitation of the most suitable part of the core in a bipolar reduction, and adequate removal of irregularities.
7. Spatial layout: Except for the largest blade, which was removed (used?) some 11 m to the East, all of the debitage was found closely concentrated within the Rekem 13 scatter.

Refitting of Rekem 13: general observations

With a score of 53%, refitting at Rekem 13 was quite successful. Moreover, it cannot be fully excluded that both co-sets described above, as well as most of the refit sets, originally belonged to a single block. This also accounts for most of the other artefacts, but not for a few exhausted cores, nor for the backed point. As no tools have been refitted, one wonders what may have been the purpose of this knapping sequence. Discard of at least one small exhausted core of a completely deviating flint type at this location might point to a possible explanation: the sequence(s) at Rekem 13 might represent the preparation of a new core destined to replace the exhausted specimen(s), and intended for further exploitation elsewhere(?).

4.4.2.10 Rekem 15

Co-set 15c01 (Pl. 60; Map 98)

1. Refit state: 11 artefacts, including the core, provide a general outline of the knapping procedure.
2. Original nodule: Dim. min. 13.5 x 10 x 7.5cm; coarse-grained good quality flint with slightly weathered chalk cortex (type 15/21). Irregular knobbed form (protuberances and cavities).
3. Reduction sequence: The installation of the first platform (A) has not been refitted. It was used to produce a few cortical flakes, creating core table (I), and was then rejuvenated (flakes refitted). Again some blanks were detached along the same core table, of which only a few could be refitted. The final attempts seemed unsuccessful (many flakes hinged), and platform (A) was abandoned. The core was also exploited form the opposite side (platform B), using a reduction surface slightly sideways to core table (I). No members of this sequence could be refitted, and it is not possible to reconstruct its exact relation to platform (A). In any case, the output seemed reduced, and the final flake(s) also hinged.
4. Core/abandonment: Dim. 11 x 7 x 7.5cm. On both reduction surfaces, the last blanks suffered from deep hinging. However, an adequate rejuvenation, and shaping of the core flanks should have allowed further exploitation of the volume.
5. Productivity: Poor. Mainly cortical flakes and flakes which had suffered from hinging. No tools refitted; no use-wear observed.
6. Quality of knapping: Poor to mediocre. Given the quality and the volume of the raw material, the production could have been much richer.
7. Spatial layout: Except for the core, which was separated a little to the North, all products clustered centrally at Rekem 15.

Co-set 15c02 (Pl. 61; Map 99)

1. Refit state: 7 artefacts, including the core.
2. Original nodule: Dim. min. 10 x 8.5 x 5.2cm; raw material similar to 15c01: coarse-grained good quality flint with slightly weathered chalk cortex (type 15/21); irregular form (protuberances and cavities).
3. Reduction sequence: The core was exploited from two sides, but as the sequences along the respective reduction faces did not meet, it is difficult to determine which platform was used first. Prod-

ucts of one sequence along table (I) could be partly refitted, but the best blade(s) seems to be missing. The final blanks hinged. The second reduction face (II), situated sideways, also suffered from hinging. Together, the organisation of the reduction, and the state of the final core, were almost identical to 15c01.
4. Core/abandonment: Dim. 8 x 7 x 5cm. Although there are indications of hinging, it could have been further exploited.
5. Productivity: A few laminar flakes. One was modified into a burin (Pl. 88: 3), but seemingly left unused.
6. Quality of knapping: Mediocre. No specific organisation of the volume.
7. Spatial layout: All products, including the burin and the core, clustered in the SE sector of Rekem 15.

Co-set 15c03 (Pl. 61; Map 100)

1. Refit state: 7 blanks, detached from various sides, and the core, provide a good account of the reduction procedure.
2. Original nodule: Dim. min. 8 x 8 x 4cm; coarse-grained good quality flint with chalk cortex and one ancient fracture face (type 15/22). Flat nodule with craggy exterior.
3. Reduction sequence: The sequence started along two adjacent narrow sides of the nodule. Whereas one was probably essentially considered as striking platform (A), and the other as core table (I), both were in fact reduced in a swiftly alternating rhythm with at least seven changes of debitage direction. This procedure generated a few cortical laminar flakes, of which one was modified into a burin. The knapper then rotated the core and started exploiting it from the opposite side (B). Few elements could be refitted there, but it seems that mainly laminar flakes were produced. In a final sub-sequence, platform (A) was used again to detach some blanks from the back of the core. They also removed a substantial part of the core base, and reduced its length considerably. Finally, a few small blanks were again detached along table (I) from platform (B), but they all hinged.
4. Core/abandonment: Dim. 4.5 x 5.5 x 3.5cm. Both the reduced length of the core table and hinging of some blanks may have been the reasons for discard.
5. Productivity: Some laminar flakes. One element was modified into a burin (Pl. 88: 4), but was seemingly left unused.
6. Quality of knapping: Poor to mediocre. The knapping procedure lacks systematic organisation, and barely produced useful blanks.
7. Spatial layout: Most elements, including the burin, were found in the south-central part of the concentration. One extremely small bladelet was situated two metres to the North, while the core was found at the same distance to the South.

Co-set 15c04 (Pl. 62; Map 101)

1. Refit state: A conjoinment of 6 laminar flakes and a blade.
2. Original nodule: Dim. unknown; raw material and cortex are completely identical to 15c01 and 15c02 (type 15/21).
3. Reduction sequence: A unidirectional sequence of cortical blades and laminar flakes, launched along a convex flank of the nodule.
4. Core/abandonment: Unknown.
5. Productivity: One (unused) cortical blade.
6. Quality of knapping: Unknown.
7. Spatial layout: All elements were found centrally in the concentration, together with the blanks from 15c01 and 15c02.

Co-set 15c05 (Pl. 62; Map 102)

1. Refit state: Despite the limited number of refitted artefacts (N=6, core included), both the appearance of the original nodule, and the reduction system, are reconstructed accurately.
2. Original nodule: Dim. 5.5 x 5.5 x 6cm; small nodule of coarse-grained good quality flint with a battered chalk cortex (type 15/23).
3. Reduction sequence: The co-set illustrates a simple but efficient unidirectional reduction. The removal of one large cortical flake created a striking platform (A), that served throughout the entire sequence, without renewal. Although most of the subsequent reduction was not refitted, one flake clearly took part in preparing a crest. The other (laminar) flakes reduced the core table that eventually exploited half of the nodule perimeter.
4. Core/abandonment: Dim. 4 x 4 x 4cm. The back is still cortical. The abandoned core manifests traces of burning.
5. Productivity: Poor, if reckoned in terms of respectable blades, but given the size of the original nodule, it may be surprising that some laminar flakes were indeed produced. No traces of use.
6. Quality of knapping: Standard procedure of unidirectional laminar reduction on a small nodule.
7. Spatial layout: Most elements were situated in the central part of the concentration. The core was isolated a few metres to the East.

Co-set 15c06 (Pl. 62; Map 103)

1. Refit state: With 6 refitted artefacts (core included), the reduction process is documented only partly.
2. Original nodule: Dim. unknown; coarse-grained flint with, in part, a thick, chalk cortex and some internal flaws (type 15/22).
3. Reduction sequence: Nothing of the initial shaping of the core, nor could the installation of the first platform (A) be physically refitted. The refitted part documents the final stages of the reduction, comprising exploitation of the former core basis, and a

final detachment along the front core table (I).
4. Core/abandonment: Dim. 6.5 x 5 x 6cm. Attempts to exploit the front core table from the opposite direction apparently failed (severe hinging).
5. Productivity: Unknown. Probably, the more regular elements are lacking. The two refitted blades are cortical, and lack traces of use.
6. Quality of knapping: the apparent lack of organisation might be (partly) due to the limited state of refitting.
7. Spatial layout: Most finds were situated in the central part of the concentration. The core was discovered a few metres further East.

Refitting of Rekem 15: general observations

Refitting of Rekem 15 generated by far the highest score (63% of the artefacts, including all the cores and both the tools). The refit sets and most of the other artefacts, though not (yet) physically connected, probably also belong with the co-sets described above. These beneficial results will be fully exploited in the spatial analysis presented in chapter 6 (section 6.2.1).

On the whole, the reduction sequences lack any signs of proficient knapping qualities. They are poorly organised, generated numerous knapping accidents, and produced an extremely poor output of (laminar) flakes, both in terms of quality and quantity.

4.4.2.11 Rekem 16

Co-set 16c01 (Pl. 63-64; Map 93 & 106)

1. Refit state: This co-set is built with 27 flakes and flake fragments. The core is missing.
2. Original nodule: Dim. 29.2 x 16.4 x 11.2cm; a very large, almond-shaped nodule of coarse-grained good quality flint (type 16/29; so-called Valkenburg flint).
3. Reduction sequence: Although there are no signs of a laminar project in the present reconstruction, it seems that the sequence primarily prepared a core with 2 opposed striking platforms. The first two removals on one end of the nodule (platform A) were guided along a natural ridge. One of those, found at Rekem 15, could be refitted. Next, a very large cortical blank was detached along a flat face of the nodule. This piece broke into 4 fragments. After detachment of another flake from platform (A), the core was rotated and exploited from the opposite end (B). A series of at least 10 flakes were removed from that end, some very thick. In all, this sub-sequence reduced the length of the core by 10cm. After the removal of a flake from the flank of the core, the remaining volume was probably transported from Rekem 16 to Rekem 12 (see spatial analysis below). There was, however, no apparent change in the style of reduction. All subsequent removals were again thick flakes or fragments, struck from various directions, but again essentially exploiting side (A). One of these was abandoned at Rekem 15.
4. Core/abandonment: Dim. max. 14.2 x 10.3 x 7.1cm. The reasons for abandonment are unknown, but given the large residual volume it is likely that the core was transported for further exploitation to (yet) another locus (see spatial analysis below).
5. Productivity: Except for a few elongated products, this sequence essentially produced thick flakes. None of these has been modified into a tool, nor have any traces of use-wear been observed.
6. Quality of knapping: No indication of substantial knapping know-how. There was no attempt of organising the volume for blade production, nor any preparation of the butts. In fact, the sequence may be assessed as a spoliation of flint material, possibly while testing the nodule in search of 'good' flint areas.
7. Spatial layout: The spatial distribution of the elements of this block is very different from what we usually observe at Rekem. This is not only because of the elements' occurrence at three different loci (Rekem 16, 12, and 15), but also because of their wide spreading within the loci of Rekem 12 and Rekem 16[21]. Various hypothetical scenarios could explain such a pattern of distribution. For instance, if one accepts a continuous displacement of the core being reduced, the knapper(s) would have successively visited Rekem 15, Rekem 16, Rekem 12, Rekem 15, and again Rekem 12. A more likely scenario, however, seems that knapping occurred in the two locations where a cluster of artefacts can be observed, namely in the SE sector of Rekem 16, and in the N extension of Rekem 12. From both knapping spots, artefacts may then have been transported to various directions within the loci (also to the main scatters of Rekem 12 and Rekem 16), as well as to Rekem 15. The dispersed artefacts are generally large flakes or laminar flakes, while small flakes or fragments were left at the supposed knapping spots. Still, as microwear traces are lacking, we fail to explain the purpose of the transport of blanks to various distant locations. Finally, a mixture of both scenarios is also possible.

In chronological terms, the sequence reveals the following successions of attendance:

- Certain successions:
  1) from Rekem 16 to Rekem 12
  2) from Rekem 12 to Rekem 15
- Possible successions:
  1) from Rekem 15 to Rekem 16 (in case the core was being transported)
  2) from Rekem 16 to Rekem 15 (transport of artefact)
  3) from Rekem 15 to Rekem 12 (transport of the core).

In short, if we may indeed accept that this nodule was an integral part of the *Federmesser* assemblage (and we see no reason to reject that), it provides solid arguments for the contemporaneity of these 3 loci. Its real significance, however, remains enigmatic.

[21] The image is so different indeed, that we were at a certain moment in doubt as to whether this pattern could possibly result from a falsification, perhaps produced by one of the excavators. In fact, this appears to be impossible. Not only do soil concretions on the artefacts testify of a prolonged sojourn in sediments, the fieldnotes also show that the individual specimens were excavated in different field seasons by different persons (including the first author).

Co-set 16c02 (Pl. 65; Map 107)

1. Refit state: With 17 blanks refitted on the core, this co-set documents about the entire reduction sequence.
2. Original nodule: Min. 6.8 x 6.2 x 4.4cm; medium-sized, angular block of coarse-grained, good quality flint (type 16/22).
3. Reduction sequence: This co-set is a good illustration of a 'straightforward' but efficient bi-directional reduction on a fairly small nodule. The primary removals of the sequence are not refitted, but core preparation seems to be lacking (no indications of cresting, no platform installation). The reduction started along a narrow side of the nodule (core table I), using a 'natural' face as striking platform (A), and generating a series of small blades and laminar flakes, once interrupted by a single removal from the opposite platform (B; an ancient fracture face). A second production from platform (B) is not refitted, but consisted of at least 3 blades and a final small hinging flake. Platform (A) then served again for the removal of a very thick flake that eliminated a few protuberances, and for the production of a few blades. Final attempts were unsuccessful (hinging flakes), and the knapping direction changed for the last time to platform (B), for a generation of some 5 short thin laminar products. The blanks of this reduction sequence occasionally exploited the entire core table (*i.e.* to the opposite platform), but mostly only travelled about 2/3 of the core table length. Shifting from one platform to the other apparently occurred when the knapper met problems of hinging.
4. Core/abandonment: Dim. 5.6 x 4.0 x2.5cm. Except for its reduced size, there was no apparent reason for discard.
5. Productivity: Relatively high: mostly (short) blades and laminar flakes; no tools refitted; no use-wear observed.
6. Quality of knapping: With a systematic bipolar reduction, lacking any core preparation or rejuvenation, the knapper successfully obtained a series of thin laminar products.
7. Spatial layout: 3/4 of the artefacts, including the core, are concentrated in 1 sq m in the northern half of the main scatter at Rekem 16. A few elements are scattered more peripherally.

Co-set 16c03 (Pl. 66; Map 108)

1. Refit state: 28 refitted elements, including the core. A major part of the sequence is still missing (several parts of it are certainly represented by the smaller sets of Rekem 16), but the co-set provides a good impression of the general debitage procedure.
2. Original nodule: min. 13.5 x 10.5 x 9.2cm; large block partly with chalk cortex, partly with eroded surface, good quality flint (type 16/21), but with occasional internal flaws.
3. Reduction sequence: The reduction started along a natural ridge formed by the intersection of the cortex with an ancient natural fracture face, creating core table (I). It is uncertain to what degree the striking platform (A) had been initially prepared (the proximal parts of the first refitted blanks are missing), but after removal of the primary elements along the ridge, platform (A) was in any case substantially reduced. It then served to launch a new series of laminar (often cortical) elements, exploiting an ever 'expanding' core table (I). Platform (A) was renewed again twice, and after some elements had suffered from hinging, the exploitation turned to the opposite platform (B), to detach a very thick large flake that removed the entire core table. After this detachment, the direction of the reduction turned 90°. After removal of a few thick cortical flakes, the former core flank (a) subsequently served as striking platform (C), from which the former core table (I) was now exploited in the changed direction (*i.e.* perpendicularly). The sequence continued as a bipolar reduction, with a rapid rhythm of platform alternation (at least 5 times), but with a rather poor output, which mainly consisted of thick plunging (at the end also hinging) flakes, quickly reducing the remaining volume of the core. During the final phase of the reduction, a few small flakes were laterally detached from the back of the core.
4. Core/abandonment: Dim. 6.8 x 5.7 x 3.9cm. The main core table suffered from hinging flakes.
5. Productivity: Mostly thick flakes, occasionally a more laminar product. No tools refitted; no use-wear observed.
6. Quality of knapping: Poor to mediocre. There was no initial shaping of the original nodule, only a constant adaptation to its momentary form. In spite of the very large initial volume, the knapper did not manage to successfully produce a well-elaborated laminar series. Instead, the flint material was more or less 'spoiled' in thick robust flakes.
7. Spatial layout: Most of the pieces are concentrated on a very limited surface in the main scatter of Rekem 16. A few elements are slightly more peripheral. The core was discarded a few metres further to the East.

Co-set 16c04 (Pl. 67; Map 109)

1. Refit state: a conjoinment of 14 flakes or flake fragments, a poor illustration of the reduction *an sich*, but which most likely represents an initial phase of the reduction sequence 16c03.
2. Original nodule: Unknown from the present reconstruction, but cf. 16c03 (flint type 16/21).
3. Reduction sequence: A sequence of cortical flakes removed from 2 opposite striking platforms along a natural outer surface. One of the striking platforms has been reduced.
4. Core/abandonment: unknown, but cf. 16c03.
5. Productivity: Flakes and cortical flakes. No tools, no used elements.
6. Quality of knapping: Unknown from the present reconstruction.
7. Spatial layout: Completely overlapping with the distribution of 16c03.

Co-set 16c05 (Pl. 67; Map 110)

1. Refit state: 29 artefacts, including the core. Very good reconstruction (almost complete).
2. Original nodule: Dim. min. 12.7 x 7.0 x 8.7cm (good estimation); homogeneous coarse-grained good quality flint (type 16/25), with a few internal flaws; a rounded and knobbed nodule.
3. Reduction sequence: The initial blanks are not refitted, but the reduction seems to have started with the removal of a large protruding knob. The large negative thus created shortly served as a striking platform, but because of the concavities in the nodule, the removals could not travel very far. Alternatively, they might be regarded as crest preparatory flakes on the later core table (I). After detachment of another thick cortical flake, perpendicular to the former one, thus creating platform (A), the crest-like edge of the first platform was indeed removed, and this side of the nodule further served as the main core reduction face (core table I). Platform (A) was renewed (no refits), and the reduction continued along core table (I), generating a series of flakes and laminar flakes. This procedure of platform renewal and blank production was repeated twice throughout the entire reduction sequence. On 3 occasions, there were also lateral removals along the core flank, which again shaped unifacially crested blanks. The two final removals both suffered from deep hinging.
4. Core/abandonment: Dim. 7.8 x 3.1 x 3.5cm. Although the length of the core was still exploitable, hinged removals had severely destroyed the core table. The bottom and back of the core are still completely cortical.
5. Productivity: Only flakes and laminar flakes. In all, an estimated number of 40 to 50 blanks must have been produced. One cortical element has been selected to shape a reamer (Pl. 103: 6; note that, while completely cortical, this blank was detached near the end of the sequence). None of the artefacts presented microscopic traces of use.
6. Quality of knapping: Mediocre. While the knobbed shape of the original nodule was certainly not very adequate, the knapper managed to produce a considerable number of blanks, but no regular blades. The system consisted of simple unidirectional reduction with occasional rejuvenation of the platform.
7. Spatial layout: Most elements are concentrated in exactly the same 1 sq m as the pieces from 16c02, in the northern half of the main scatter at Rekem 16. A few elements, including the core and the reamer, are scattered more peripherally, but always within ± 5 sq m.

Co-set 16c06 (Pl. 65; Map 111)

1. Refit state: a few blanks and several lumps; almost complete reconstruction of the original nodule.
2. Original nodule: dim. 12.3 x 7.3 x 5cm; elongated nodule of good quality flint, but apparently with internal flaws (flint type 16/20).
3. Reduction sequence: Very limited. After a few short removals along the longest natural ridge, the nodule shattered into fragments when the blow for the first 'serious' blank was delivered.
4. Core/abandonment: Core in numerous fragments, partly also intensively burnt.
5. Productivity: A few short laminar flakes, nothing very useful, and nothing used.
6. Quality of knapping: unknown from this reconstruction, but apparently uncritical nodule selection.
7. Spatial layout: Blanks cluster in the same area as co-sets 16c02 and 16c05 (in the main scatter of the concentration). Lumps are a bit more widely dispersed, with the burnt fragments occurring in the E part of the concentration.

Co-set 16c07 (Map 111)

Complete reconstruction of a crumbled flint cobble, possibly tested by a knapper, and shattered at the moment of impact. The fragments were found dispersed in the SE periphery of Rekem 16.

Refitting of Rekem 16: general observations

Refitting at Rekem 16 has been very successful (including 47% of the artefacts), and has generated the highest average number of pieces per refit group (N=7). Both unipolar and rapidly alternating bipolar knapping sequences have been observed. Two knapping positions might be discerned within the main scatter in the NW part of the locus: one for co-sets 16c03 and 16c04 (*i.e.* flint type 16/21), and another, a bit more to the North, for co-sets 16c02 and 16c05 (and possibly 16c06). Most of the refit sets can be ascribed to one of these groups. A large tested nodule was found next to this main scatter. The anomalous co-set 16c01, however, completely deviates from this pattern. Apparently, this block was partly reduced in the SE area of Rekem 16, and some of its biggest flakes were then widely dispersed all round. The crumbled cobble 16c07 reveals a more or less similar distribution.

Another peculiar phenomenon at Rekem 16 is the remarkable separation between the debitage sequences in the NW part, and the tooling (refits) in the SE area. In fact, except for one reamer in 16c05, the co-sets do not include any tools, nor any traces of usewear. We will, of course, return to this observation in the spatial analyses (chapter 6).

4.4.3 State of refitting and evaluation of the database

As reported in the introduction of this chapter, 2311 elements so far could be refitted within one of the 521 refit groups of habitation zone 1 at Rekem. Just over half of these (N=1181) are integrated in one of the 86 co-sets (*i.e.* in refit groups with at least

Table 25

Rekem habitation zone 1. Number of refit groups by locus.

* This number refers to the artefacts that were counted in the refitting groups ascribed to the locus, and may include artefacts from a different locus, hence the differences in comparison with the totals of other tables.

	Locus												
	1	4	5	6	7	8	10	11	12	13	15	16	Total
N refitted co-sets	11	2	27	7	7	-	5	8	4	2	6	7	86
N artefacts in refitted co-sets	143	25	480	55	49	-	84	71	57	38	44	135	1181
Average N artefacts/co-set	13	13	18	8	7	-	17	9	14	19	7	19	14
N refitted sets	43	9	120	67	29	-	63	25	43	6	7	23	435
N artefacts in refitted sets	118	24	313	168	76	-	153	67	110	17	19	65	1130
Average N artefacts/set	3	3	3	3	3	-	2	3	3	3	3	3	3
Total N sets+co-sets	54	11	147	74	36	0	68	33	47	8	13	30	521
Total N refitted artefacts*	261	49	793	223	125	0	237	138	167	55	63	200	2311
Average N artefacts/refit group	5	4	5	3	3	-	3	4	4	7	5	7	4

6 elements); the others (N=1130) are conjoined in 435 sets including 5 artefacts at most (Table 25). On average, the refit groups at Rekem consist of 4 elements, but there are of course large deviations, ranging from 2 to 87 artefacts per single group.

In proportion to the total inventory (and excluding the chips), the refitting artefacts represent 21% of the entire flint assemblage of habitation zone 1 (Table 26). In terms of artefact types, the best results were gained for debris (93% has been refitted)[22], and cores (59%). Good scores were also obtained for edge-damaged pieces (43%), tooling waste products (35%), and core rejuvenation products (33%). Still above average are the refitting results for the tools (24%), but there are major differences among the various tool types, ranging from 10% for slender LMP to 41% for burins (see section 5.1.2). Finally, as for the debitage products, while dominating the refits in absolute numbers, only 18% of the entire population of blade(let)s and (laminar) flakes could be conjoined (Table 26).

The exact significance of this quantitative divergence is not obvious. 'Simple' flakes and bladelets, without distinctive features, for instance, are generally not easily refittable. On the other hand, tools may have received a slight (unconscious) preferential treatment during the refitting process. Although this was certainly not consciously intended during the proper refitting process, tools are looked at more often (typology, microwear), and may thus eventually have a better chance of being recognised and refitted. Moreover, the higher refitting score for tools indicated in Table 26 also includes tooling refits. In case of tool waste refits, this is in fact by far the most common type of conjunction.

The various refitting types for the entire assemblage are summarised in Table 27. In all, some 82% of the refitting artefacts are involved in debitage re-

22 This is hardly surprising, as these were mostly blocks that were broken on the spot.

Table 26

Rekem habitation zone 1. Number of refitting artefacts by locus.

* Chips are not included, as they have not been involved in the refitting procedure.

	Locus												Total	Total N	%
Artefact*	1	4	5	6	7	8	10	11	12	13	15	16	refitted	pieces	refitted
Cores	19	4	19	17	9	-	12	14	5	1	5	7	112	191	58.6%
Core rejuvenation products	19	4	39	6	12	-	10	8	6	2	1	5	112	340	32.9%
Blade(let)s and (laminar) flakes	172	37	458	162	77	-	164	79	123	46	57	134	1509	8560	17.6%
Debris (lumps)	3	3	35	16	3	-	-	2	7	-	-	17	86	92	93.5%
Retouched tools	25	1	101	18	17	-	23	13	14	-	2	9	223	931	24.0%
Edge-damaged pieces	17	-	62	4	5	-	11	8	13	2	-	8	130	300	43.3%
Tool waste products	9	-	63	15	3	-	15	14	10	1	-	9	139	398	34.9%
Total refitted	264	49	777	238	126	0	235	138	178	52	65	189	2311	10812	21.4%
Total pieces*	1694	191	3036	1788	658	18	1120	684	1015	98	104	406	10812		
% refitted	16%	26%	26%	13%	19%	0%	21%	20%	18%	53%	63%	47%	21.4%		

Table 27
Rekem habitation zone 1. Number of artefacts involved in various types of refitting by locus.

	Locus												
Refitting type	1	4	5	6	7	10	11	12	13	15	16	Total	%
Debitage	178	40	458	147	107	146	85	120	42	63	125	1511	65%
Tooling	4	-	42	20	6	18	13	15		-	11	129	6%
Fracture	22	3	94	46	8	39	11	19	1	-	22	265	11%
Debitage+tooling	10	-	45	3	-	4	4	-	1	-	-	67	3%
Debitage+fracture	50	6	126	22	5	25	25	24	8	2	31	324	14%
Tooling+fracture	-	-	2	-	-	3	-	-	-	-	-	5	0%
Debitage+tooling+fracture	-	-	10	-	-	-	-	-	-	-	-	10	0%
Total	264	49	777	238	126	235	138	178	52	65	189	2311	100%
%	11%	2%	34%	10%	5%	10%	6%	8%	2%	3%	8%	100%	

fits, sometimes combined with a fracture conjoinment (14%), a tooling refit (3%), or, exceptionally, both. Simple tooling refits represent 6%; 11% of the refitting artefacts are connected in a break only.

Finally, it should be noted, that the achievements of the refitting work have not been equally successful at the various loci. Leaving aside the sparse, non-refitted artefacts of Rekem 8, the refitting rates range from 13% (at Rekem 6) to 63% (at Rekem 15; Table 26). Whereas these results might to a certain degree be ascribed to the impact of the refitter, obviously, the variation must also hold a systemic significance. We will return to this issue in the spatial analyses (chapter 6). In the present chapter, we primarily focus on the technological insights that can be gained from the conjoinments.

Although further refitting work might certainly add to the results, we nevertheless believe that the present database can solidly foster the following discussion on operational aspects of the flint knapping processes at Rekem.

4.5 Flint knapping at Rekem: a flexible process

In this section, we will attempt to reconstruct the knapping scheme(s), as conceived and executed by the *Federmesser* artisans at Rekem, following the knapping process from the procurement of raw blocks to the selection of blanks for modification and use.

4.5.1 Raw material selection

As pointed out in section 4.2, the *Federmesser* inhabitants at Rekem could easily exploit the flint-carrying gravel deposits of the Meuse riverbed and terraces. Nearly all the flint varieties found at the site can indeed still be traced in these localities. Practical reasoning would therefore suggest that the bulk of the flint material was indeed recovered from local sources. However, the exploitation of a wider region cannot be entirely excluded. In fact, Meuse flint is widely dispersed in the area.

In any case, at Rekem, lithic raw material displays great variety in quality, size, and morphology. Let us shortly consider these aspects in detail.

4.5.1.1 Quality

If we may assume that (most of) the flint blocks were indeed collected from the (nearby) river deposits of the Meuse, a comparison might be made with the quality of the 'natural' flint cobbles as they appear today. Based on our survey in 1991, it is clear that the present-day gravels certainly include appropriate raw materials for knapping purposes. However, the flint material is of inconsistent quality, often suffering from frost damage, and frequently including internal flaws. The attitude of the *Federmesser* collectors towards the flint cobbles seems to have been ambiguous. On the one hand, the apparent absence at the site, of the primary (cortical) flakes struck from 'tested blocks' (see section 4.3.3), suggests that the flint cobbles were sounded during procurement activities, or at least before their introduction into the camp. On the other hand, the assemblage at Rekem contains numerous 'crumbled cobbles', *i.e.* blocks that had shattered into fragments on the site, at the moment of impact. Many of these could be completely refitted (*e.g.* 05c30-32, 05s124-125, 06c07, 16c06-07). Other blocks appear to have broken into just a few (large) fragments which were then further reduced separately. In these instances, the flat surfaces and sharp ridges on these items were advantageously exploited, as they could directly serve as striking platforms or guiding ridges (*e.g.* 01c01, 01c04, 05c07, 05c13, 11c04, 11c06, 12c01).

In all, in terms of quality, although some inspection may have taken place, flint procurement was apparently not guided by consistent selection mechanisms.